Message

From:	Shade, Kevin [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=8936BA302F244901826AE021A71D658D-SHADE, KEVIN]
Sent:	1/29/2021 2:26:58 PM
To:	Glascock, Jay [jay.glascock@lm.doe.gov]; Young, Mary [Mary.Young@lm.doe.gov]; Devine, Rachel (CONTR) [rachel.devine@lm.doe.gov]; Lewis, Brent [Brent.Lewis@lm.doe.gov]
Subject:	RE: Impending General Notice Letter to DOI and DOE -- Cleanup of San Mateo Creek Basin Mines
Attachments:	GNL Enclosures Combined Final - DOE.pdf

Here is the attachment for the DOE letter.

Kevin

From: Glascock, Jay <jay.glascock@lm.doe.gov>
Sent: Thursday, January 28, 2021 5:02 PM
To: Shade, Kevin <Shade.Kevin@epa.gov>; Young, Mary <Mary.Young@lm.doe.gov>; Devine, Rachel (CONTR) <rachel.devine@lm.doe.gov>; Lewis, Brent <Brent.Lewis@lm.doe.gov>
Subject: RE: Impending General Notice Letter to DOI and DOE -- Cleanup of San Mateo Creek Basin Mines

Thanks, Kevin! This is a huge help! Can you send us an electronic copy of the enclosures? Or, point us to where this is posted for the public? ...assuming we can find the enclosures there. Jay

From: Shade, Kevin <Shade.Kevin@epa.gov>
Sent: Thursday, January 28, 2021 3:55 PM
To: Young, Mary <Mary.Young@lm.doe.gov>; Devine, Rachel (CONTR) <rachel.devine@lm.doe.gov>; Lewis, Brent <Brent.Lewis@lm.doe.gov>
Cc: Glascock, Jay <jay.glascock@lm.doe.gov>
Subject: [EXTERNAL] RE: Impending General Notice Letter to DOI and DOE -- Cleanup of San Mateo Creek Basin Mines

Hi Mary and all –

Quick summary -

EPA sent general notice letters to two federal agencies, DOE and DOI, in connection with the uranium mining in the San Mateo Creek Basin, indicating potential liability under CERCLA. EPA's determination was based partially on DOE as being the successor to the Atomic Energy Corporation.

The letter to DOE is attached and is public.

Kevin

From: Young, Mary <Mary.Young@lm.doe.gov>
Sent: Thursday, January 28, 2021 4:04 PM
To: Devine, Rachel (CONTR) <rachel.devine@lm.doe.gov>; Shade, Kevin <Shade.Kevin@epa.gov>; Lewis, Brent <Brent.Lewis@lm.doe.gov>
Cc: Glascock, Jay <jay.glascock@lm.doe.gov>
Subject: RE: Impending General Notice Letter to DOI and DOE -- Cleanup of San Mateo Creek Basin Mines

Thanks Rachel!

Kevin,

90044975

Do you have any documents you can share so I can familiarize myself with the project before we meet?

Mary Young
U.S. Department of Energy
Office of Legacy Management
Defense-Related Uranium Mine Program
Project Manager
2597 Legacy Way
Grand Junction, CO 81503
Work Cell: 970.712.4992

From: Devine, Rachel (CONTR) <rachel.devine@lm.doe.gov>
Sent: Thursday, January 28, 2021 3:02 PM
To: Young, Mary <Mary.Young@lm.doe.gov>; Shade, Kevin <Shade.Kevin@epa.gov>; Lewis, Brent <Brent.Lewis@lm.doe.gov>
Cc: Glascock, Jay <jay.glascock@lm.doe.gov>
Subject: RE: Impending General Notice Letter to DOI and DOE -- Cleanup of San Mateo Creek Basin Mines

You should receive the invite soon

Thank you,
Rachel Devine
Contractor to the U.S. Department of Energy
Office of Legacy Management Operations Center
Executive Administrative Assistant III
11035 Dover Street, Suite 600
Westminster, CO 80021
(M): 575-499-5158
(W): 303-410-4836 / (F): 720-377-3829

From: Young, Mary <Mary.Young@lm.doe.gov>
Sent: Thursday, January 28, 2021 2:17 PM
To: Shade, Kevin <Shade.Kevin@epa.gov>; Lewis, Brent <Brent.Lewis@lm.doe.gov>; Devine, Rachel (CONTR) <rachel.devine@lm.doe.gov>
Cc: Glascock, Jay <jay.glascock@lm.doe.gov>
Subject: RE: Impending General Notice Letter to DOI and DOE -- Cleanup of San Mateo Creek Basin Mines

Great, let's say 9am MST/10am CT so we can discuss the basics then I can bring in LMSP next week if needed.

Rachel, would you mind setting up a conference phone call for 9am tomorrow and invite Brent, Kevin Shade, and myself. Thanks!

Mary Young
U.S. Department of Energy
Office of Legacy Management
Defense-Related Uranium Mine Program
Project Manager
2597 Legacy Way
Grand Junction, CO 81503

Work Cell: 970.712.4992

From: Shade, Kevin <Shade.Kevin@epa.gov>
Sent: Thursday, January 28, 2021 2:11 PM
To: Lewis, Brent <Brent.Lewis@lm.doe.gov>; Young, Mary <Mary.Young@lm.doe.gov>; Glascock, Jay <jay.glascock@lm.doe.gov>
Subject: [EXTERNAL] RE: Impending General Notice Letter to DOI and DOE -- Cleanup of San Mateo Creek Basin Mines

Tomorrow anytime except 12-1 and 2:45-3:15 Central Time.
Monday is good except for 10-11, 1-2, and 2:45-3:15, all Central Time.

From: Lewis, Brent <Brent.Lewis@lm.doe.gov>
Sent: Thursday, January 28, 2021 3:07 PM
To: Young, Mary <Mary.Young@lm.doe.gov>; Glascock, Jay <jay.glascock@lm.doe.gov>; Shade, Kevin <Shade.Kevin@epa.gov>
Subject: RE: Impending General Notice Letter to DOI and DOE -- Cleanup of San Mateo Creek Basin Mines

I have time tmw or Monday.

Brent Lewis
Office of Legacy Management
Defense-Related Uranium Mine Program
Technical Lead and Project Manager
11035 Dover Street
Westminster, CO 80021-5587
720.377.3823 - office
301.802.0968 - cell

From: Young, Mary <Mary.Young@lm.doe.gov>
Sent: Thursday, January 28, 2021 1:40 PM
To: Glascock, Jay <jay.glascock@lm.doe.gov>; Lewis, Brent <Brent.Lewis@lm.doe.gov>; Shade, Kevin <Shade.Kevin@epa.gov>
Subject: RE: Impending General Notice Letter to DOI and DOE -- Cleanup of San Mateo Creek Basin Mines

I will get right on it. Thanks Jay!

Brent and Kevin, do you have time for a quick call today, tomorrow, or Monday morning to discuss details? I was thinking about inviting Clay Carpenter and Steve Renner from Navarro depending on their availability.

Thanks,
Mary Young
U.S. Department of Energy
Office of Legacy Management
Defense-Related Uranium Mine Program
Project Manager
2597 Legacy Way
Grand Junction, CO 81503
Work Cell: 970.712.4992

From: Glascock, Jay <jay.glascock@lm.doe.gov>
Sent: Thursday, January 28, 2021 1:26 PM
To: Young, Mary <Mary.Young@lm.doe.gov>
Cc: Lewis, Brent <Brent.Lewis@lm.doe.gov>; Shade, Kevin <Shade.Kevin@epa.gov>
Subject: Impending General Notice Letter to DOI and DOE -- Cleanup of San Mateo Creek Basin Mines

Mary,

Please work with Brent, Kevin (EPA), and LMSP to put together an information paper by Friday (Feb 8). When this impending EPA Region 6 general notice letter hits DOE, I want to ensure we have the necessary background as it relates to the DRUM program. Most likely, this letter will be addressed to DOE's Office of the General Counsel, but it may go to the Secretary. In any case, we need to be ready for questions. In the paper, we'll need a short introduction of the DRUM program, an overview of what EPA envisions with the San Mateo Creek Basin, a short view of the future collaboration expected of DOI, DOE, EPA, and DOJ, a map of the area showing the mine locations, identifying the mines that are part of the DRUM program (if not all of them), and provide a status and way ahead, like which PRPs are EPA working with to put together the remedial investigation and feasibility studies.

In my recollection, EPA Region 6 is overseeing three former mine operators who are conducting the groundwater remedial investigation and feasibility studies of the lower portion of the San Mateo Creek Basin. This work will identify the nature and extent of the contamination, assess the risk to human health and the environment, and assess cleanup options.

Thanks,
Jay

****
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Use caution if this message contains attachments, links or requests for information.

****

SAN MATEO CREEK BASIN LEGACY URANIUM MINES SUPERFUND SITE
ENCLOSURE 1

U.S. DEPARTMENT OF ENERGY LIABILITY INFORMATION

1. Bachman, G.O., et al. "Reconnaissance for Uranium-Bearing Carbonaceous Rocks in New Mexico." *Trace Elements Investigations Report 198*, 1952, United States Department of the Interior Geological Survey.
    a. Page 5-11

2. United States Department of the Interior Geological Survey. "Trace Elements Reconnaissance Investigations in New Mexico and Adjoining States in 1951." *Trace Elements Memorandum Report 433*, 1951.
    a. Pages 5, 8-9

3. Cook, Kenneth L., and Calvin K. Moss. "Geophysical Observations in Parts of the Grants District, McKinley County, New Mexico." *Trace Elements Investigations Report 244*, Aug. 1952.
    a. Pages 5-6, 10

4. Stead, Frank W. "Airborne Radioactivity Survey in the Vicinity of Grants, McKinley and Valencia Counties, New Mexico." *Trace Elements Memorandum Report 161 United States Department of the Interior Geological Survey*, July 1951.
    - Pages 4, 13

5. Defense Minerals Exploration Administration Historical Files

Tei 198

Reconnaissance for Uranium-Bearing Carbonaceous Rocks in New Mexico, 1952

By G. O. Bachman, E. H. Baltz, and R. B. O'Sullivan

Trace Elements Investigations Report 198

Geology and Mineralogy

This document consists of 20 pages
Series A

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

RECONNAISSANCE FOR URANIUM-BEARING CARBONACEOUS ROCKS IN NEW MEXICO, 1952*

By

G. O. Bachman, E. H. Baltz, and R. B. O'Sullivan

March 1953

Trace Elements Investigations Report 198

This preliminary report is distributed without editorial and technical review for conformity with official standards and nomenclature. It is not for public inspection or quotation.

*This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

USGS - TEI Report 198

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RECONNAISSANCE FOR URANIUM-BEARING CARBONACEOUS ROCKS IN NEW MEXICO, 1952

By

G. O. Bachman, E. H. Baltz, and R. B. O'Sullivan

ABSTRACT

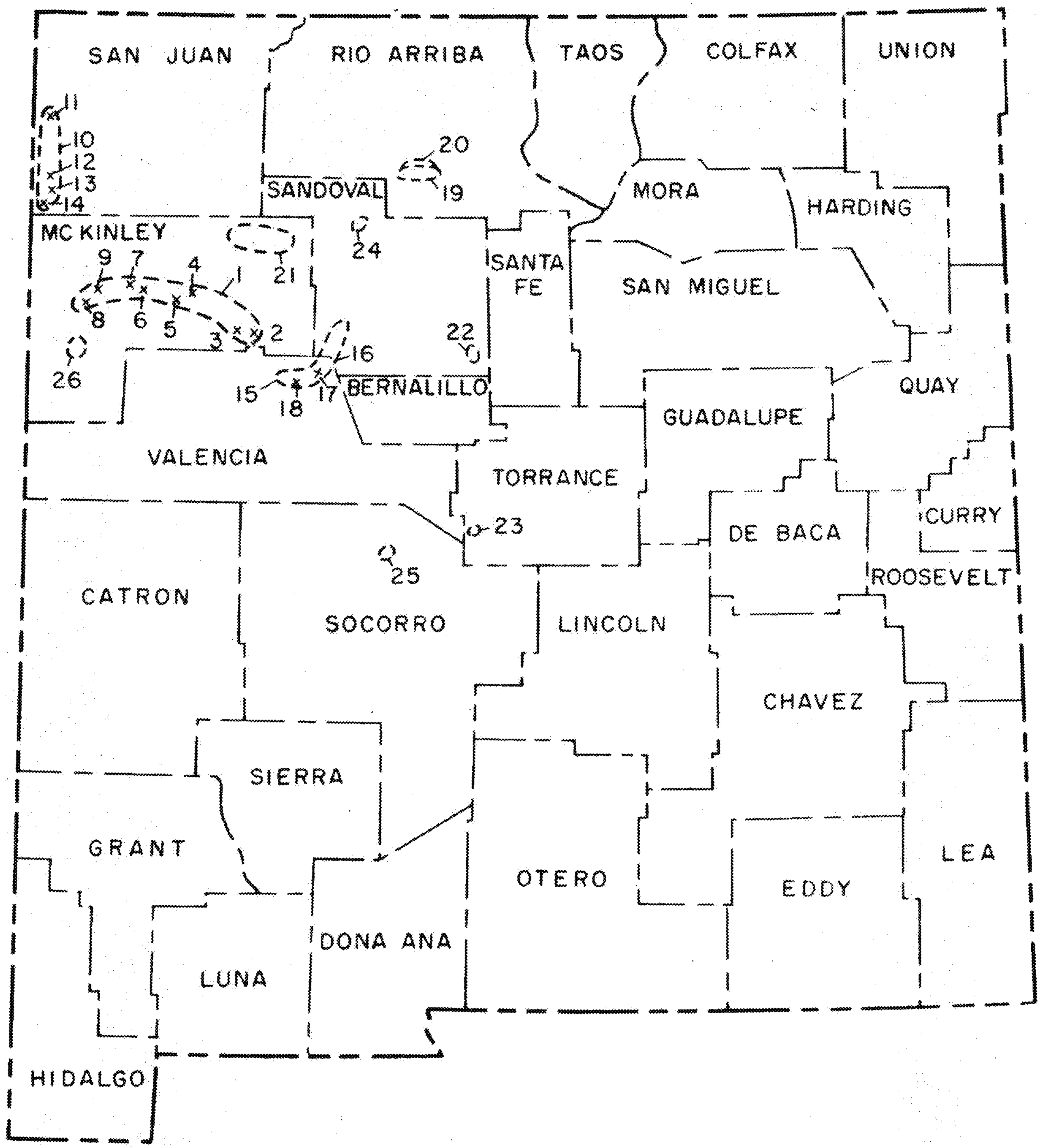
Reconnaissance for uranium in coal and black shale in New Mexico during 1952 was largely an extension of work initiated during the 1951 field season. No uranium deposits of economic interest were found, although minor amounts of uranium were noted at several localities.

INTRODUCTION

During the 1952 field season the writers made a geologic reconnaissance search for uranium in coal and black shale (fig. 1). The work was chiefly a continuation of reconnaissance studies initiated in 1951 (Bachman and Read, 1952). Several areas outlined for study in 1951, were examined more thoroughly during 1952, and several new occurrences of uranium were found. Analyses were made in the Denver and Washington Trace Elements Laboratories of the Geological Survey. This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

SOUTH MARGIN OF SAN JUAN BASIN, McKINLEY COUNTY

Upper Cretaceous rocks form the southern rim of the San Juan Basin, McKinley County. These rocks were examined between Grants and Gallup, a distance of about 60 miles, in July 1952. Upper Cretaceous rocks listed in ascending order are the Dakota sandstone, the Mancos shale, and the Mesaverde formation. The Mesaverde formation and the upper part of the Mancos shale



EXPLANATION

1. South margin of San Juan Basin
   2. San Mateo dome
   3. Canyon Mulatto
   4. Satan Pass
   5. Hosta Butte
   6. Mariana Pass
   7. Dalton Pass
   8. Pyramid Rock
   9. "Kit Carson's Cave"

10. Chuska Mountain area
   11. Beautiful Moutain
   12. Toadlena
   13. Washington Pass
   14. Crystal

15. Mount Taylor and vicinity
   16. Mesa Chivato
   17. Seboyeta Canyon
   18. Guadalupe Canyon

19. Gallina-Coyote area
   20. Mesa Alta

21. Chacra Mesa
22. Hagen Basin
23. Scholle Copper district
24. Cuba Mesa area
25. San Acacia area
26. Gallup-Zuni basin

Index Map of New Mexico

0 10 30 50 MILES
SCALE

FIGURE 1

have been subdivided into several members by Sears (1934).

The structure of the southern part of the San Juan Basin is relatively simple. From the southern rim of the basin, which is arbitrarily defined as the southern line of outcrop of the Dakota sandstone, strata dip 3° to 10° northward into the basin. Mount Taylor, a late Tertiary volcano, and the Zuni uplift are prominent geographic and structural features at the south edge of the basin.

Carbonaceous material occurs in the Dakota sandstone and in the Gallup, Dilco, and Gibson members of the Mesaverde formation (Sears, 1934). Outcrops were given careful examination for several miles at many places. Radioactivity was found in carbonaceous material in the Dakota sandstone and in the lower Gibson member of the Mesaverde formation.

Radioactivity in the lower Gibson member occurs in discontinuous zones of shale, coal, and carbonaceous material near the contact of the lower Gibson member with the overlying Hosta sandstone. The lower Gibson member and the Hosta sandstone member of the Mesaverde formation crop out at San Mateo dome, about 5 miles north of San Mateo. This zone was examined carefully for a distance of about 3 miles along the south edge of the dome without finding abnormal radioactivity.

At the head of Canyon Mulatto, 6 miles northwest of the San Mateo dome, in the NW¼, sec. 24, T. 14 N., R. 9 W., radioactivity was found in the lower Gibson member directly below its contact with the overlying Hosta sandstone. A lens of coaly material about 3 inches thick contains 0.035 percent uranium (BONM-5)[1/]. A sample from the basal portion of the Hosta sandstone

1/ Sample numbers are listed by area in the Appendix.

at this locality contained 0.005 percent equivalent uranium and 0.002 percent uranium (BONM-13).

On the north side of Canyon Mulatto in the N½ sec. 14, T. 14 N., R. 9 W., uranium was found in a discontinuous lens of shale 2½ inches thick at the base of the Hosta sandstone. The shale contains 0.020 percent equivalent uranium and 0.014 percent uranium (BONM-6). A grab sample taken from the Gibson member at the contact with the Hosta sandstone about 85 feet west of this locality contained 0.007 percent uranium (BONM-7).

This zone of radioactivity was examined continuously from locality BONM-6 eastward into the south half of section 12 and the north half of section 13 on both sides of the canyon. On the north rim of Canyon Mulatto in the SE¼, sec. 12, T. 14 N., R. 12 W. a 1-foot bed of carbonaceous shale in the lower Gibson member was sampled directly below the contact of the lower Gibson member with the Hosta sandstone. The sample contained 0.014 percent equivalent uranium and 0.005 percent uranium (BONM-14). The radioactivity was in the trough of a minor syncline. The syncline is approximately 150 feet wide, and its axis trends nearly north.

The Mesaverde formation was examined at many places west of Canyon Mulatto. In secs. 27 and 28, T. 15 N., R. 10 W. the stratigraphic section was examined carefully in the vicinity of the Ambrosia Fault (Hunt, pl. 18, 1936). Particular attention was given to the lower Gibson-Hosta contact in the W½ sec. 27 and in sec. 28. No abnormal radioactivity was noted in this area and no samples were collected.

Lower Gibson and Hosta rocks are exposed for a distance of about 5 miles on the sides of a prominent cuesta that extends from sec. 31, T. 16 N., R. 11 W. westward to Satan Pass. These exposures were examined throughout most of their length but radioactivity was found only at one locality east of the Thoreau-Crown Point road. In sec. 32, T. 16 N., R. 12 W. a radioactive coal bed 1-foot thick was found near the lower Gibson-Hosta contact. The uranium content of the coal apparently is discontinuous as different points on any one horizon examined did not show equal radioactivity. The coal contained 0.003 percent equivalent uranium, 0.005 percent uranium, and 0.034 percent uranium in the ash (BONM-9). Carbonaceous shale at the same locality contained 0.003 percent equivalent uranium (BONM-10). A channel sample of the upper foot of a coal bed 3 feet thick, also in sec. 32, contained 0.014 percent equivalent uranium, 0.019 percent uranium, and 0.054 percent uranium in the ash (BONM-11). The strata are deformed from slumping but all samples were collected from strata which are within a few feet stratigraphically of the lower Gibson-Hosta contact.

Outcrops of these rocks were examined at close intervals to the north through Satan Pass on both sides of the Canyon as far as sec. 16, T. 16 N., R. 12 W. but no abnormal radioactivity was noted. An examination was made of the lower Gibson-Hosta contact south of Crown Point in secs. 29 and 30, T. 17 N., R. 12 W. and of the Gallup sandstone in T. 15 N., R. 12 W., but no radioactivity was detected.

The Hosta sandstone forms the caprock of Hosta Butte in secs. 26 and 27, T. 16 N., R. 13 W. The Hosta sandstone and underlying lower Gibson member, which are exposed on the east side of the butte, were examined, but no radioactivity was discovered except near the lower Gibson-Hosta contact. There, a thin stratum of radioactive coaly material which does not exceed 3 inches in thickness, occurs in the lower Gibson member 2½ feet below the lower Gibson-Hosta contact. This material contained 0.012 percent equivalent uranium, 0.013 percent uranium, and 0.033 percent uranium in the ash (BONM-8).

The lower Gibson member and the Hosta sandstone were examined about 8 miles west of Satan Pass near the south entrance to Mariana Pass in sec. 8, T. 16 N., R. 13 W., but no radioactivity was detected. The scarps on both sides of the pass were examined also, but no abnormal radioactivity was noted. In the NE¼, SW¼, sec. 5, T. 16 N., R. 13 W. a lens of carbonaceous shale 1.8 feet thick contained 0.009 percent uranium (BONM-12). In the NW¼, sec. 2, T. 16 N., R. 14 W. a bed of carbonaceous shale 0.7 feet thick contained 0.013 percent equivalent uranium and 0.016 percent uranium (BONM-16). Both of these shale beds are at the lower Gibson-Hosta contact.

The lower Gibson and Hosta rocks were examined in Dalton Pass, about 4 miles west of Mariana Pass. For about 6 miles to the west no radioactivity was detected except at a ridge due north and across the valley from Dalton Pass, approximately in sec. 28, T. 17 N., R. 14 W. There the Hosta sandstone rests directly on a lens of impure coal that is about 3 inches thick and contains 0.025 percent uranium with 0.038 percent uranium in the ash (BONM-15).

Two occurrences of uranium are known in the Dakota hogback about 3 miles east of Gallup. One of these, about 1½ miles north of U.S. Highway 66, is in carbonaceous shale. The other occurrence is more closely associated with sandstone. Because of the association of uranium with carbonaceous material some attention was given to other Upper Cretaceous carbonaceous rocks in this area. Coal and carbonaceous shale in the Gallup, Gibson, and Dilco members of the Mesaverde formations in the northern part of T. 16 N., R. 18 W. and in the northwestern part of T. 16 N., R. 17 W. were examined, but no abnormal radioactivity was detected.

The caprock of Pyramid rock, in the SE$\frac{1}{4}$ sec. 3, T. 15 N., R. 17 W., consists of Dakota sandstone that contains a small quantity of interbedded carbonaceous shale. The shale is slightly radioactive but no samples were collected. Radioactivity was found in a bed of carbonaceous shale 4 feet thick in the Dakota sandstone above Kit Carson's Cave which is about 2 miles east of Pyramid Rock. The upper 1.5 feet of the shale contains 0.012 percent equivalent uranium and 0.008 percent uranium (BONM-17A), and the lower 2.5 feet contained 0.004 percent equivalent uranium (BONM-17B).

Parts of the southern San Juan Basin were surveyed by airborne detection equipment under the direction of J. Meuschke of the Geological Survey. Seven east-west flight lines, each about 25 miles long, were flown in T. 16 N., R. 14 to 18 W. No radioactivity anomalies were recorded.

CHUSKA MOUNTAIN AREA

During the reconnaissance work carried on during 1951, radioactive coal was discovered in the Tocito sandstone of Late Cretaceous age on Beautiful Mountain in San Juan County, New Mexico (Bachman and Read, 1952). Because of this occurrence of uranium-bearing coal, the Chuska Mountain area was examined during the 1952 season. However, exposures in many parts of the Chuska Mountains are too poor for effective reconnaissance with radioactivity detecting instruments.

In a hogback east of Toadlena, the Tocito sandstone contains abundant interbedded carbonaceous material. These rocks were examined carefully from the Newcomb-Toadlena road southward for a distance of about 4 miles to the point where they are covered by Tertiary rocks. The Dakota sandstone and the Todilto limestone also were examined at closely spaced points along the hogback. No abnormal radioactivity was detected.

In Washington Pass, Tertiary igneous rocks are slightly radioactive. A grab sample (BONM-28) of gray tuff contained 0.0037 percent equivalent uranium and 0.0001 percent uranium. A sample (BONM-29) of diabase contained 0.0056 percent equivalent uranium and 0.0005 percent uranium.

Isolated exposures of the Morrison formation and the Todilto limestone were examined east and south of Crystal, but no radioactivty was detected.

MOUNT TAYLOR AND VICINITY

Mount Taylor is flanked by Mesa Chivato, a basalt-capped plateau which extends northward and northeastward for several miles in southeastern McKinley County (Hunt, 1936). Reconnaissance was undertaken along the east side of Mesa Chivato where a relatively thick sequence of Upper Cretaceous strata containing carbonaceous material is well exposed. Upper Cretaceous rocks that crop out east of Mount Taylor include in ascending order, the Dakota sandstone, the Mancos shale, and the Mesaverde formation. In general, these strata dip gently westward into the Mount Taylor syncline.

Coal and carbonaceous material in the lower Gibson member of the Mesaverde formation on the north side of Seboyeta Canyon were examined, but no radioactivity was detected. The line of cliffs from Seboyeta north to Marquez, a distance of about 6 miles, was examined and found to be non-radioactive.

A basalt-capped plateau also extends about 7 miles south from Mount Taylor. The plateau there is terminated by cliffs of Upper Cretaceous rocks that were examined at numerous localities but which are not radioactive. Numerous coal beds are well exposed in a fork of Guadalupe Canyon in sec. 15, T. 11 N., R. 8 W., but no radioactivity was detected.

Upper Cretaceous rocks are poorly exposed near the top of Mount Taylor and were examined but were not found to be radioactive.

GALLINA-COYOTE AREA

The Gallina-Coyote area, Rio Arriba County, is about 53 miles northwest of Santa Fe and 15 miles northeast of Cuba. The topography of the area is extremely varied, altitudes ranging from 6,700 feet at Coyote to more than 10,000 feet on San Pedro Mountain, about 5 miles south of Gallina. Pre-Cambrian metamorphic and igneous rocks, Tertiary igneous rocks, and sedimentary rocks that range in age from Pennsylvanian to Recent are exposed in the area. Most attention was given to rocks of Jurassic and Cretaceous age, although other rocks were examined briefly.

Along New Mexico State Highway 96, between Coyote and Gallina, sedimentary rocks are exposed. Permian "red beds" of the Cutler formation are overlain by the Chinle formation of Triassic age. Jurassic rocks include the Entrada sandstone and the Wanakah and Morrison formations. To the north of the highway, Mesa Alta is capped by the Dakota sandstone of Cretaceous age. To the west of Mesa Alta the stratigraphic sequence includes the Dakota sandstone, the Mancos shale, the Mesaverde formation, the Lewis shale, Pictured Cliffs sandstone, Fruitland-Kirtland formation, the Ojo Alamo sandstone, the Nacimiento group, and the Wasatch formation.

Exposures on Mesa Alta were examined in some detail. Along a line of cliffs at the south end of the mesa the Wanakah and Morrison formations were carefully examined in secs. 13, 14, 15, 22, 23, and 24, T. 23 N., R. 2 E. The Dakota sandstone was examined over much of Mesa Alta. However, slumping and vegetation cover much of the Dakota sandstone and good exposures are rare. No abnormal radioactivity was detected in the Dakota sandstone on Mesa Alta.

A series of hogbacks composed of Cretaceous rocks were examined west of Gallina. Carbonaceous shale and coal in both the Dakota sandstone and the

Mesaverde formation are well exposed at numerous places and were examined at selected points along the hogback for about 14 miles. No radioactivity was detected.

Other places in the Gallina-Coyote area where radioactivity surveys were made include Cerro Pedernal about 6 miles south of Coyote (carbonaceous material in the Dakota sandstone); the north and west sides of San Pedro Mountain (Cutler "red beds"); and Mesa Pinebestosa (the Madera formation). No abnormal radioactivity was detected, and no samples were collected.

CHACRA MESA, McKINLEY COUNTY

Upper Cretaceous and Tertiary rocks in the vicinity of Chacra Mesa, McKinley County (Dane, 1936) were briefly examined during 1952. The stratigraphic section was examined at many places from Crown Point northward to Whitehorse Trading Post, and from there eastward to Cabezon with a scintillation detector. No radioactivity was noted in this area except for a shale at the base of the Ojo Alamo sandstone about 1 mile southeast of Pueblo Bonito National Monument in Chaco Canyon. The shale (BONM-25) contains 0.001 percent equivalent uranium.

HAGEN BASIN, SANDOVAL COUNTY

Brief reconnaissance was done in the Hagen Basin in the southeast part of Sandoval County. Jurassic and Upper Cretaceous sedimentary rocks and Tertiary igneous rocks were examined. The Wanakah formation of Jurassic age was examined north of Golden and at other points on the east side of the Hagen Basin, but no radioactivity was detected. Coal in the Mesaverde formation of Upper Cretaceous age was examined at several localities in the vicinity of the deserted town of Hagen but is not radioactive. A sill composed of quartz monzonite porphyry was sampled in the NE$\frac{1}{4}$, sec. 4, T. 12 N., R. 6 E. about a quarter of a mile east of the Diamond Trail Ranch house. The sample contained 0.010 percent equivalent uranium and 0.002 percent uranium (BONM-1). The sill intrudes the Mancos shale of Late Cretaceous age. The upper contact of the sill with the Mancos shale was obscured by alluvium; however, shale immediately underlying the sill is baked and slightly radioactive. Two samples of the shale, BONM-2 and BONM-3, contained 0.004 and 0.002 percent equivalent uranium respectively.

SCHOLLE COPPER DISTRICT

The Scholle copper district is in Abo Pass about 13 miles west of Mountainair, Torrance County. Copper minerals are associated with carbonaceous material in the Permian Abo formation. Prospects consisting of several trenches, an adit, and a shaft in a valley about three-fourths of a mile southeast of Scholle were examined for radioactivity. A sample of the most radioactive material observed, an arkose, contained 0.016 percent equivalent uranium and 0.008 percent uranium (BONM-19). The zone from which this sample was collected could not be followed because of a cover of alluvium. The Abo formation was examined from this point northward towards the south end of the Manzano Mountains for about 10 miles. Numerous abandoned copper mines and prospects were examined, but no abnormal radioactivity was detected.

CUBA MESA AREA

Cuba Mesa is 2 miles west of Cuba in Sandoval County. Rocks exposed on Cuba Mesa are of Tertiary age and are divided into two major units. The lower unit, the Nacimiento group, consists of 400 to 800 feet of shale and

and sandstone. The upper unit, the Wasatch formation, is approximately 1,000 feet in thickness and is composed of sandstone, shale, and conglomerate. The lower part of the Wasatch formation forms the caprock of Cuba Mesa, where it is about 200 feet thick.

The Wasatch formation was examined about 1½ miles north of Cuba along New Mexico State Highway 44, where carbonaceous shale and fragments of fossil wood were found to be radioactive. A sample of carbonaceous siltstone (BONM-20) contained 0.012 percent equivalent uranium and 0.002 percent uranium.

Exposures on Cuba Mesa were examined along the south and southwest part of the mesa in secs. 1, 2, and 10, T. 20 N., R. 2 W., and secs. 33 and 36, T. 21 N., R. 2 W. At a few localities sediments near the base of the cliff-forming Wasatch formation contained radioactive carbonaceous material. A sample of a sandstone near the base of the Wasatch formation in the NW¼, sec. 1, T. 20 N., R. 2 W. contained 0.006 percent equivalent uranium and 0.003 percent uranium (BONM-22). Talus has covered most of the zone where radioactivity has been found on Cuba Mesa; consequently an adequate appraisal could not be made of the potentialities of this area.

SAN ACACIA AREA

The Datil formation in the San Acacia area, Socorro County, consists of rhyolite, tuffaceous sandstone and clay, and conglomerate made up of volcanic rocks. A cobble (BONM-31) from a conglomerate in the Datil formation about 7 miles west of U.S. Highway 85 and about a mile south of the Rio Salado, contained 0.0042 percent equivalent uranium and 0.0002 percent uranium. The cobbles in the conglomerate here appear to be somewhat more basic in composition than in the Datil formation at other places. A sample (BONM-32) of a white tuffaceous sandstone about half a mile south of the outcrop of conglomerate contained 0.0022 percent equivalent uranium and 0.0001 percent uranium. A sample (BONM-33) from a 1-foot clay bed overlain by the sandstone contained 0.0009 percent equivalent uranium and 0.0001 percent uranium.

GALLUP-ZUNI BASIN

A sample (BONM-26) of tuff of Tertiary age was collected about 15 miles south of Gallup, McKinley County, in a road cut on New Mexico State Highway 32. It contained 0.0051 percent equivalent uranium and 0.0003 percent uranium.

LITERATURE CITED

Dane, C. H., 1936, Geology and fuel resources of the southern part of the San Juan Basin, New Mexico: U.S. Geol. Survey Bull. 860-C.

Hunt, C. B., 1936, Geology and fuel resources of the southern part of the San Juan Basin, New Mexico: U.S. Geol. Survey Bull. 860-B.

Sears, J. D., 1934, Geology and fuel resources of the southern part of the San Juan Basin, New Mexico: U.S. Geol. Survey Bull. 860-A.

UNPUBLISHED REPORT

Bachman, G. O. and Read, C. B., 1952, Trace elements reconnaissance investigations in New Mexico and adjoining states in 1951: U.S. Geol. Survey Trace Elements Memo. Rept. 443.

APPENDIX

Field number	Lab. number	Rock type	Equivalent uranium (percent)	Uranium (percent)	Uranium in ash (percent)	Notes
Southern edge of San Juan Basin, McKinley County						
BONM-4	87743	Shale	0.007	0.008		Channel sample of 1.3' shale; NW$\frac{1}{4}$, sec. 24, T. 14 N., R. 9 W. Immediately below Hosta-lower Gibson contact.
BONM-5	87744	Coal	0.038	0.035		Coal lenticle 3 inches thick selected from 1.3' channel sample BONM-4.
BONM-13	87752	Sandstone	0.005	0.002		Hosta ss. immediately above channel sample BONM-4.
BONM-6	87745	Siltstone and shale	0.020	0.014		N$\frac{1}{2}$, sec. 14, T. 14 N., R. 9 W.; shale and silty zone in Hosta ss. (at base). 5" thick.
BONM-7	87746	Shale	0.008	0.007		Grab sample 85' west of BONM-6. At lower Gibson-Hosta contact.
BONM-14	87753	Shale	0.014	0.005		Chip sample SW$\frac{1}{4}$, sec. 12, T. 14 N., R. 9 W., 1 foot shale at base of Hosta ss.
BONM-9	87748	Coal	0.003	0.005	0.034	Channel sample, coal 1 foot thick. N$\frac{1}{2}$, sec. 32, T. 16 N., R. 12 W.
BONM-10	87749	Carb. shale	0.003			Grab sample carb. shale associated with BONM-9.
BONM-11	87750	Coal	0.014	0.019	0.054	Upper 1' of 3' bed. In slumped material near BONM-9.
BONM-8	87747	Coal	0.012	0.013	0.033	Impure coal 0.1' thick. 2.4' below base of Hosta ss. Hosta Butte, SW$\frac{1}{4}$, sec. 26, T. 16 N., R. 13 W.

APPENDIX (CONT.)

Field number	Lab. number	Rock type	Equivalent uranium (percent)	Uranium (percent)	Uranium in ash (percent)	Notes
Southern edge of San Juan Basin, McKinley County (Cont.)						
BONM-12	87751	Carb. shale	0.008	0.009		
BONM-16	87755	Carb. shale	0.013	0.016		Carb. shale 0.7' thick at basal contact of Hosta ss. on point to west of Mariana Pass.
BONM-15	87754	Coal	0.022	0.025	0.038	Impure coal 0.2' thick on ridge due north and across valley from Dalton Pass.
BONM-17A	87756	Shale	0.012	0.008		Upper 1.5' of 4' carb. shale near base of Dakota ss. above Kit Carson's Cave.
BONM-17B	87757	Shale	0.004			Lower 2.5' of 4' carb. shale. Same locality as BONM-17A.
Chuska Mountain area						
BONM-28	D-75652	Tuff	0.0037	0.0001		Tuff at top of Washington Pass.
BONM-29	D-75653	Diabase	0.0056	0.0005		
BONM-27	D-75651	Tuff	0.0049	0.0002		In road cut west of Toadlena; may be in Chuska ss.
BONM-30	D-75654	Clay	0.0006	0.0001		
Chacra Mesa						
BONM-25	101936	Carb. shale	0.001			

APPENDIX (CONT.)

Field number	Lab. number	Rock type	Equivalent uranium (percent)	Uranium (percent)	Uranium in ash (percent)	Notes
Hagen Basin						
BONM-1	87740		0.010	0.002		
BONM-2	87741	Shale	0.004			Mancos shale contacting sill (BONM-1).
BONM-3	87742	Shale	0.002			Mancos shale below contact with sill.
Scholle Copper district						
BONM-19		Arkose	0.016	0.008		
Cuba Mesa area						
BONM-20	D-72617	Carb. siltstone	0.012	0.002		
BONM-22	D-72618	Sandstone	0.006	0.003		
San Acacia area						
BONM-31	D-76582	Andesite (?)	0.0042	0.0002		
BONM-32	D-76583	Tuffaceous sandstone	0.0022	0.0001		
BONM-33	D-76584	Clay	0.0009	0.0001		
Gallup-Zuni basin						
BONM-26	D-75650	Tuff	0.0051	0.0003		

Trace Elements Reconnaissance Investigations in New Mexico and Adjoining States in 1951

Trace Elements Memorandum Report 443

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
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WASHINGTON 25, D.C.

October 31, 1952

AEC - 424/3

Dr. Phillip L. Merritt, Assistant Director
Division of Raw Materials
U. S. Atomic Energy Commission
P. O. Box 30, Ansonia Station
New York 23, New York

Dear Phil:

Transmitted herewith are six copies of Trace Elements Memorandum Report 443, "Trace elements reconnaissance investigations in New Mexico and adjoining states in 1951," by George O. Bachman and Charles B. Read, October 1952.

Uranium in possible commercial amounts was found at La Ventana Mesa, Sandoval County, New Mexico. These deposits and the plans for their further investigation are discussed in TEI-241, which is in preparation and should be transmitted soon.

Slightly uraniferous coal and carbonaceous shale were found near San Ysidro, Sandoval County, and Beautiful Mountain, San Juan County, New Mexico, and at Keams Canyon, Navajo County, and near Tuba City, Coconino County, Arizona. None of these occurrences appear to be of immediate economic importance, but additional reconnaissance has been under way this field season in these general areas.

Sincerely yours,

Arthur P Butler Jr

for W. H. Bradley
Chief Geologist

JAN 30 2001

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Geology - Mineralogy

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UNITED STATES DEPARTMENT OF THE INTERIOR

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Classification changed to Unclass.
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by Nancy Yarnell date 8/25/55

TRACE ELEMENTS RECONNAISSANCE INVESTIGATIONS IN NEW MEXICO AND ADJOINING STATES IN 1951*

By

George O. Bachman and Charles B. Read

October 1952

Trace Elements Memorandum Report 443

This preliminary report is distributed without editorial and technical review for conformity with official standards and nomenclature. It is not for public inspection or quotation.

*This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission

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CONTENTS

ILLUSTRATIONS

TRACE ELEMENTS RECONNAISSANCE INVESTIGATIONS IN NEW MEXICO AND ADJOINING STATES IN 1951

By George O. Bachman and Charles B. Read

ABSTRACT

In the summer and fall of 1951, a reconnaissance search was made in New Mexico and adjacent states for uranium in coal and carbonaceous shale, chiefly of Mesozoic age, and black marine shale of Paleozoic age. Tertiary volcanic rocks, considered to be a possible source for uranium in the coal and associated rocks, were examined where the volcanic rocks were near coal-bearing strata.

Uranium in possibly commercial amounts was found at La Ventana Mesa, Sandoval County, N. Mex. Slightly uraniferous coal and carbonaceous shale were found near San Ysidro, Sandoval County, and on Beautiful Mountain, San Juan County, all in New Mexico, and at Keams Canyon, Navajo County, and near Tuba City, Coconino County, in Arizona. Except for the La Ventana deposit, none appeared to be of economic importance at the time this report was written, but additional reconnaissance investigations have been underway this field season, in the areas where the deposits occur.

Marine black shale of Devonian age was examined in Otero and Socorro Counties, New Mexico and Gila County, Arizona. Mississippian black shale in Socorro County and Pennsylvanian black shale in Taos County, New Mexico also were tested. Equivalent uranium content of samples of these shales did not exceed 0.004 percent.

Rhyolitic tuff from the Mount Taylor region is slightly radioactive as is the Bandelier tuff in the Nacimiento region and in the Jemez Plateau. Volcanic rocks in plugs and dikes in the northern Chuska Mountains and to the north in New Mexico as well as in northeastern Arizona and southeastern Utah are slightly radioactive. Coal and carbonaceous rocks in the vicinity of these and similar intrusions are being examined.

INTRODUCTION

During 1951 the writers made a geologic reconnaissance of portions of New Mexico and adjoining states in search of uranium, primarily in black shales and carbonaceous rocks and in an effort to evaluate the potentialities of certain regions for uranium prospecting in the future. This work was done on behalf of the Atomic Energy Commission. Various reconnaissance radiometric techniques were used in the search for uranium in each region as each offered different geologic problems. Carborne radiometric equipment was used to traverse extensive areas with the objective of eliminating negative areas. Carborne equipment could not be taken into certain areas but regions which showed relatively high background gamma ray count--indicating that bodies of disseminated radioactive elements were present--were examined in more detail for possible local concentrations of minerals. Inaccessible areas were traversed as frequently as possible on foot with portable Geiger counters.

Instruments used in geologic reconnaissance consisted of a carborne gamma ray counter equipped with two 46-inch Geiger-Mueller cathode tubes; a portable gamma ray counter equipped with a 24-inch Geiger-Mueller cathode tube, portable gamma-beta counters of the Nuclear type, and a Berkeley scaler. The carborne counter and the portable 24-inch cathode tube were used to locate areas of high background gamma ray count (i.e. rock types containing minute but abnormal quantities of radioactive elements).

GENERAL CONSIDERATIONS

It is the writers' belief that, to be most effective, reconnaissance for uranium deposits must be considered in connection with the framework of the geology of the region. Areas judged most likely to contain deposits of uranium, based on the present knowledge of the geologic conditions under which uranium occurs, should be examined first and in the greatest detail. Seemingly less favorable areas then should be considered.

Particular attention has been given to the search for rock types which contain disseminated radioactive elements. This search has been stimulated by the possibility that locally, under favorable geologic conditions, radioactive minerals may be concentrated from such disseminated bodies. Thus, volcanic rocks, tuffaceous sediments, and arkose often contain small amounts of uranium which could be concentrated by geologic agents in favorable receptor rocks.

Receptor rocks include:

1. Carbon and carbonaceous materials, such as coal and carbonaceous shale, probably adsorb or otherwise concentrate the uranyl ion (Tolmachev, 1943). Hence they are suitable receptors for the concentration of uranium carried by ground water, either past or present.

2. Clay minerals of relatively large space lattice may concentrate uranium through ionic exchange or adsorption (Frederickson, 1948).

In addition to the above receptor materials limestone may be of some importance in the concentration of uranium. Notestein (1918) has stated that "calcite readily precipitates vanadium and uranium from vanadyl and uranyl sulphate solutions."

The distribution of coal and carbonaceous rocks in New Mexico is relatively well known, as are the broad outlines of the chief areas of volcanic flows, tuffs, and associated materials. Where volcanic rocks and tuffs are concerned, it is necessary also to consider the probable former extent of the potential source rocks as well as their present distribution. The places where receptor rocks and possible source rocks are associated were examined first.

REGIONS[1/] INVESTIGATED

Carbonaceous beds were examined in eight regions during the 1951 field season. Most of the regions contained extrusive igneous rocks or were adjacent to igneous activity. These include the following (figs. 1 and 2):

1. Datil Mountain region
2. Zuni-Gallup Basin region

1/In the present discussion region refers to a geographic area of rather broad extent. Area refers to a portion of a region, and locality refers to individual outcrops or lines of outcrop within an area. Areas described in this report do not necessarily fall within the confines of previous mapping projects.

3. Carthage, Sierra Blanca, and Engle regions
4. Mount Taylor region including the San Mateo area
5. San Ysidro and La Ventana areas in the Nacimiento region
6. Chuska Mountain region
7. Black Mesa region
8. Miscellaneous areas

Marine black shale bodies of various ages were examined at a number of localities and sandstone-type copper deposits were examined where present in the regions studied.

Datil Mountain region, New Mexico

The Datil Mountain region in Socorro, Catron, and Valencia Counties, New Mexico, has been mapped and described by Winchester (1921). Cretaceous coal-bearing strata of Mesaverde age are overlain locally by the Tertiary Datil formation. The Mesaverde strata consist of interbedded sandstone, shale, and subbituminous coal. The coal beds are relatively thin and lenticular. The Datil formation is composed of conglomerate, and andesitic and rhyolitic tuff. The Datil formation was checked radiometrically in the field at numerous localities but no abnormal radioactivity was observed. Coal beds were checked radiometrically throughout the stratigraphic section in Jaralosa Canyon and at positions high in the stratigraphic section in Red Canyon with negative results. As radioactivity was not noted, no samples were collected in the Datil Mountain region.

Zuni-Gallup Basin region, New Mexico

The Zuni-Gallup Basin in Valencia and southern McKinley Counties, New Mexico, has been mapped and described by Sears (1925). Interbedded sandstone, shale, and subbituminous coal of the Mesaverde formation of Upper Cretaceous age is present over most of the region. McCann (1938) has described Tertiary sediments with white tuff and bentonitic clay resting unconformably on the Mesaverde formation in the Zuni Basin. The tuffaceous material was examined by the writers at several points along New Mexico State Highway 32 between Gallup and Zuni. Coal beds a few feet stratigraphically below the erosional unconformity were also examined. Abnormal radioactivity was not found in either the tuff or the coal and no samples were collected.

Carthage, Sierra Blanca, and Engle regions, New Mexico

The Carthage, Sierra Blanca, and Engle regions in Socorro, Lincoln, and Sierra Counties, New Mexico, were examined briefly. Basic igneous intrusions of Tertiary age are in close association with carbonaceous and coal-bearing strata of Upper Cretaceous age. Abnormal radioactivity was not observed in either the igneous rocks or the carbonaceous beds. One sample (Sample 17) from a carbonaceous shale in the Upper Cretaceous about 5 miles east of Engle contained 0.002 percent equivalent uranium, which is not considered significant.

Mount Taylor region, New Mexico

A slightly radioactive tuff is widespread in the Mount Taylor region in McKinley and Valencia Counties, New Mexico. The tuff is a potential source for radioactive elements; carbonaceous beds in the Dakota sandstone and the Mesaverde formation may be important factors in the concentration of uranium derived from the tuff. The geology of the Mount Taylor region has been described by Gardner (1910) and by Hunt (1936, 1937).

Hunt (1937, p. 58) attributes the tuff to the earliest period of eruption of Mount Taylor and describes it as a rhyolitic tuff that is distinctly bedded. Other types of volcanic rocks are also present. The tuff is well exposed in the Grants Ridges about 3 miles northeast of the town of Grants where a pumice mine is now being operated. The tuff is also exposed at numerous points around La Jara Mesa in the San Mateo area and on the north end of Horace Mesa. Three samples of the tuff (Samples O, 19, 20) were collected at the mine north of Grants. The samples contained from 0.002 to 0.003 percent equivalent uranium and 0.001 percent uranium. Clayey material (Sample 21) collected from a playa in the canyon below the pumice mine contains 0.004 percent equivalent uranium and 0.002 percent uranium. These percentages are significant in that they indicate the presence of disseminated uranium in the Mount Taylor region. The tuffaceous material is porous and permeable which makes it readily susceptible to leaching by ground water solutions. Under favorable geologic conditions the disseminated uranium may be concentrated in rock units in close proximity to the present, or past, distribution of the tuff.

Cretaceous carbonaceous rocks and coal have been examined radiometrically at numerous points in the Mount Taylor region with negative results. At the places examined so far, however, the rocks between the carbonaceous material and the tuff have so little porosity and permeability that ground water could not readily carry mineral-bearing solutions into the carbonaceous material. At least 2,000 feet of argillaceous sediments is present between the tuff and the carbonaceous material. Coal (Sample 18) in Lobo Canyon, west of Mount Taylor, contained only 0.003 percent uranium in the ash of the coal. Samples 18 to 23 were collected in the Mount Taylor region.

Additional work in the Mount Taylor region will be aimed at finding carbonaceous material located favorably in relation to potential source rocks.

Nacimiento region, New Mexico

Mesaverde and Dakota sediments of Cretaceous age, containing coal and carbonaceous shale, crop out in the San Ysidro area in the southern portion of the Nacimiento region, Sandoval County, New Mexico (Hunt, 1936). The northern limits of the area are about 3 miles south of the town of San Ysidro. Pumiceous sediments of the Tertiary Santa Fe formation are exposed just east of the area and may have supplied radioactive elements which could have been concentrated in the carbonaceous Cretaceous sediments. Only minor radioactivity has been found in the San Ysidro area. A bed of coal 1.9 feet in thickness (Sample 25) in the Mesaverde formation contains 0.004 percent uranium in the ash. Samples 24-27 and 41-42 were collected in the San Ysidro area.

The La Ventana area in the southern part of the Nacimiento region is located just west of the highly folded and faulted pre-Cambrian and Paleozoic rocks in the Sierra Nacimiento. The geology of the area has been described by Renick (1931), Dane (1936), and Wood and Northrop (1946). Coal occurs in rocks of Mesaverde age in the vicinity of La Ventana. On the eastern flank of the Sierra Nacimiento the Bandelier tuff of Pleistocene (?) age caps many of the higher mesas. The Bandelier tuff is also widespread on the Jemez volcanic plateau to the east of the Sierra Nacimiento. The tuff contains as much as 0.006 percent equivalent uranium and 0.003 percent uranium (Samples 95, 96). The La Ventana area seemed favorable for the occurrence of uraniferous coal because of the possibility that the Bandelier tuff formerly lapped westward across the Sierra Nacimiento and thus supplied uranium which could be concentrated in the carbonaceous rocks of the Mesaverde formation.

Additional reconnaissance in the eastern part of the Nacimiento region will aim at finding other deposits of carbonaceous rocks favorably located in relation to the Bandelier tuff on the Jemez plateau.

Uranium was found in coal and carbonaceous shale in the Allison member of the Mesaverde formation on La Ventana Mesa in August, 1951, (Bachman and Read, 1951). Uranium was also found east of La Ventana Mesa in carbonaceous beds in the Gibson coal member of the Mesaverde formation and in the Dakota sandstone (Read, 1952). The coal on La Ventana Mesa contains as much as 0.62 percent uranium with 1.34 percent uranium in the ash. The La Ventana deposits are described in detail and with plans for further work by Vine, Bachman, Read, and Moore (1952, TEI-241, in preparation).

Chuska Mountain region, New Mexico and Arizona

Upper Cretaceous strata bearing coal and carbonaceous rocks are widespread in the Chuska Mountain region at San Juan County, New Mexico and Apache County, Arizona and the adjacent San Juan Basin in New Mexico. Volcanic rocks of Tertiary age are intimately associated with the Cretaceous strata. The volcanic rocks occur chiefly in plugs and are usually of basic composition. However, Gregory (1917, p. 81) has reported rhyolitic ash in the Chuska sandstone of Tertiary age.

The portion of the Chuska Mountain region examined is on the western flank of the San Juan structural basin. On Beautiful Mountain, (fig. 3) strata of Mesozoic age dip eastward into the basin from the northern extension of the Defiance uplift which bounds the San Juan Basin on the west. The Mesozoic rocks are truncated and overlain by the Chuska sandstone and other rocks and volcanic debris of Tertiary age.

Minor radioactivity was detected in carbonaceous sediments and coal of Upper Cretaceous age on Beautiful Mountain. The Upper Cretaceous Tocito sandstone includes a zone of carbonaceous material and coal at its top. Where the carbonaceous material is near the erosional surface upon which the Tertiary sediments were deposited, minor radioactivity was detected at many places. On Beautiful Mountain, the upper half of a bed of coal 1.3 feet thick contains 0.007 percent uranium (Sample 103). Immediately below a joint in the overlying strata the same bed contains 0.010 percent uranium with 0.021 percent uranium in the ash (Sample 102). Other carbonaceous material about 150 feet stratigraphically and topographically below the points sampled contained no abnormal radioactivity.

Slightly abnormal radioactivity was detected in many volcanic plugs and their associated dikes. Radioactivity was estimated to be 0.003 percent equivalent uranium. At several localities on Beautiful Mountain and on Lukachukai Mountain to the west, the Tertiary rocks and volcanic debris contain slight radioactivity. The Tertiary rocks and volcanic material thus seem to be potential source beds for secondary accumulation of uranium in the coal and carbonaceous rocks.

These Tertiary rocks and volcanic debris having slight radioactivity cap both Lukachukai Mountain and Cove Mesa and might be the source of the uranium in the Morrison formation at these places. This possibility probably would be of little importance in the exploration of the Morrison formation in that area but it should be considered in connection with any age determinations made on the Morrison ores of that area.

Black Mesa region, Arizona

The Black Mesa region (fig. 4) covers an area of about 3,000 square miles in Navajo, Apache, and eastern Coconino Counties, Arizona. Sedimentary rocks of Dakota (?) and Mesaverde age cap the mesa at most places. Coal and carbonaceous shale are prominent in these rocks. Hack (1942) has described the Bidahochi formation, which contains volcanic material, resting on Cretaceous and older deposits in the Black Mesa-Hopi Buttes regions. Both the Cretaceous carbonaceous sediments and the Bidahochi formation have been examined radiometrically. No abnormal radioactivity has been detected in the Bidahochi formation; however, minor radioactivity has been noted in carbonaceous material and natural coal ash on Black Mesa. At the Keams Canyon locality (Sample 111 and fig. 4) a coal bed 2.0 feet thick contains 0.004 percent equivalent uranium and 0.002 percent uranium. At the Tuba City coal mine, about 10 miles east of Tuba City, a natural ash contains 0.004 percent uranium (Sample 114 and fig. 4).

Miscellaneous areas

Other areas visited during the 1951 field season include the following:

1. Walsenburg area, Huerfano County, Colorado. Volcanic plugs intrude strata of Cretaceous and Tertiary age. Several acidic plugs in the vicinity of Walsenburg showed slightly abnormal radioactivity. R. B. Johnson collected a sample from the Pierre shale of Cretaceous age which showed slight radioactivity (Sample 105). The sample was collected in the contact zone of the Pierre shale with a dark igneous dike.
2. Pecos area, Santa Fe County, New Mexico. Coal of Pennsylvanian age in the Pecos Valley was examined but no abnormal radioactivity was detected.
3. Sage Plains, Montezuma County, Colorado, and San Juan County, Utah. Coal in the Dakota sandstone was examined at a number of localities along U. S. Highway 160 between Cortez, Colorado, and Monticello, Utah, but no abnormal radioactivity was detected.

4. Asphaltic sandstone of Triassic age (Santa Rosa sandstone) about 9 miles northeast of Santa Rosa, Guadalupe County, New Mexico, was examined radiometrically but with negative results.
5. Sandstone-type copper deposits. Numerous sandstone type copper deposits were examined. Minor radioactivity was detected in most of these deposits. The deposits are described in greater detail by Bachman and Read (1952).

MARINE BLACK SHALE

Marine black shale of Devonian, Mississippian, and Pennsylvanian age was examined at several localities in New Mexico and Arizona. Equivalent uranium content did not exceed 0.004 percent in any of the samples collected. Localities visited included black shale in the Madera formation of Pennsylvanian age near Tres Ritos, Taos County, New Mexico (Sample 1); Percha shale (fig. 1) of upper Devonian age in Otero and Socorro Counties, New Mexico (Samples 7-15); shale in the Lake Valley limestone of Mississippian age in Socorro County, New Mexico (Sample 16); and the upper shaly portion of the Martins limestone of Devonian age in Gila County, Arizona (Samples 106-109). Analyses of these samples are given in the appendix.

RADIOACTIVE VOLCANIC ROCKS

Radioactivity detected in volcanic rocks examined in this study was not restricted to a narrow range of petrologic types, but was detected more consistently in acidic volcanic rocks than in basic ones. The acidic Bandelier tuff of Pleistocene (?) age on the Jemez volcanic plateau and the rhyolitic tuff in the Mount Taylor region showed minor abnormal radioactivity at most places. However, the Abiquiu formation, an acidic volcanic tuff of early Tertiary age at the north end of the Jemez volcanic plateau, and a Tertiary acidic tuff in the Zuni basin were not radioactive.

Most dark volcanic rocks examined contained no radioactivity which was detectable in the field; however breccia and minette in volcanic plugs, such as Ship Rock, Mitten Butte, Ford Butte, and Bennett

Peak in San Juan County, New Mexico and Agathla Peak and similar bodies in Monument Valley, Arizona and Utah, (Williams, 1936) contain slightly abnormal radioactivity. The relatively high potassium content of minette does not appear to be sufficient to account for the radioactivity of the plugs as Twin Cones, near Gallup, New Mexico, contains a similar minette which shows no radioactivity. Several monchiquite volcanic plugs in the Hopi Buttes region were examined but were not radioactive.

PLANS

Areas in which abnormal radioactivity was detected during 1951 in coals and carbonaceous shales and potential source rocks in New Mexico and Arizona are being examined by the Survey in reconnaissance fashion this year. The areas in which the work is being concentrated and the occurrences there of abnormal radioactivity are summarized below.

1. The east flank of the Chuska Mountains, San Juan County, New Mexico from Chuska Valley southward to the vicinity of Washington Pass, including Beautiful Mountain where one sample from a coal bed in the Tocito sandstone contained 0.007 percent uranium. A brief airborne radiometric survey was made during September 1952 and, although the detailed results are not yet available, one anomaly of possible interest was found. Exposures of coal and carbonaceous shale are poor and the ground reconnaissance is being made with the most sensitive radiometric instruments available.

2. The Mount Taylor-Mesa Chivato region contains slightly uraniferous volcanic rocks resting on coal-bearing Cretaceous strata. The coal and carbonaceous rocks are being examined in detail. An important part of the investigation in this area is the study of the regional geology of the tuff to determine as far as possible the former extent of the tuff to focus attention on areas where carbonaceous rocks once were overlain by it.

3. Mesa Prieta, Sandoval County, New Mexico consists of Cretaceous coal-bearing strata capped by volcanic rocks. Little is known of the volcanic rocks but Mesa Prieta is about half way between the Mount Taylor-Mesa Chivato region and the Jemez volcanic plateau, where slightly radioactive volcanic rocks occur.

Exposures in the vicinity of Mesa Prieta are poor and reconnaissance radiometric examination is being made with the most sensitive instruments available. An airborne radioactivity survey will be made if feasible.

4. Chacra Mesa, McKinley County, New Mexico, consists of coal-bearing rocks that may once have been overlain by volcanic rocks. Preliminary reconnaissance is being undertaken.

5. The Black Mesa region contains coal-bearing rocks, and a natural coal ash at the Tuba City mine contains 0.004 percent uranium. Possible sources of the uranium have not been recognized. Some coal beds in the nearby areas could be mined by stripping and other strippable coal beds probably exist in the Black Mesa region. Coal beds and carbonaceous rocks are being examined wherever possible. In addition, reconnaissance is being continued in the Jemez Plateau and in the Nacimiento region.

Plans for work on La Ventana Mesa, Sandoval County are given in detail in TEI-241 (in preparation). Throughout the reconnaissance, data on volcanic rocks are being gathered. These data will contribute to knowledge of petrologic types of volcanic rocks containing disseminated uranium, the areal extent of these types, and the natural conditions under which uranium could be released from them.

REFERENCES

Bachman, G. O., and Read, C. B., 1951, Results of recent reconnaissance investigations of uranium in coal, black shale, and related deposits in Sandoval and Rio Arriba Counties, New Mexico: U. S. Geol. Survey Trace Elements Memorandum Rept. 309.

__________, 1952, Uranium-bearing copper deposits near Guadalupita, Mora County, New Mexico: U. S. Geol. Survey Trace Elements Memorandum Rept. 435.

Dane, C. H., 1936, The La Ventana-Chacra Mesa coal field: U. S. Geol. Survey Bull. 860-c, pp. 81-166.

Denson, N. M., Bachman, G. O., and Zeller, H. D., 1950, Summary of new information on uraniferous lignites in the Dakotas: U. S. Geol. Survey Trace Elements Memorandum Rept. 175.

Frederickson, A. F., 1948, Some mechanisms for the fixation of uranium in certain sediments: Science, vol. 108, pp. 184-185.

Gardner, J. H., 1910, The coal field between San Mateo and Cuba, New Mexico: U. S. Geol. Survey Bull. 381-c, pp. 461-473.

Gregory, H. E., 1917, Geology of the Navajo Country: U. S. Geol. Survey Prof. Paper 93.

Hack, J. T., 1942, Sedimentation and volcanism in the Hopi Buttes, Arizona: Geol. Soc. Am. Bull. No. No. 2, vol. 53, pp. 335-372.

Hunt, C. B., 1936, The Mount Taylor coal field: U. S. Geol. Survey Bull. 860-b, pp. 31-80.

Hunt, C. B., 1937, Igneous geology and structure of the Mount Taylor volcanic field, New Mexico: U. S. Geol. Survey Prof. Paper 189-B.

McCann, F. T., 1938, Ancient erosion surface in the Gallup-Zuni area, New Mexico: Am. Jour. Sci., vol. 36, 5th ser. pp. 260-278.

Notestein, F. B., 1918, Some chemical experiments bearing on the origin of certain uranium-vanadium ores: Econ. Geology vol. 13, pp. 50-64.

Read, C. B., 1952, Recent discoveries of radioactive carbonaceous shale, Sandoval County, New Mexico: U. S. Geol. Survey Trace Elements Memorandum Rept. 278.

Renick, B. C., 1931, Geology and ground water resources of western Sandoval County, New Mexico: U. S. Geol. Survey Water-Supply Paper, 620.

Sears, J. D., 1925, Geology and coal resources of the Gallup-Zuni Basin, New Mexico: U. S. Geol. Survey Bull. 767.

Tolmachev, I. M., 1943, Adsorption of uranyl salts on solid adsorbents, USSR Acad. Sci. Bull. No. 1, pp. 28-34.

Vine, J. D., Bachman, G. O., Read, C. B., and Moore, G. W., 1952, Uranium-bearing coal and carbonaceous shale in the La Ventana Mesa area, Sandoval County, New Mexico: U. S. Geol. Survey Trace Elements Investigations Rept. 241 (In preparation).

Winchester, D. E., 1921, Geology of Alamosa Creek Valley, Socorro County, New Mexico: U. S. Geol. Survey Bull. 716-a, pp. 1-15.

Wood, G. H., Jr., and Northrop, S. A., 1946, Geology of Nacimiento Mountains, San Pedro Mountain, and adjacent plateaus in parts of Sandoval and Rio Arriba Counties, New Mexico: U. S. Geol. Survey Oil and Gas Prelim. Map. 57.

Williams, Howel, 1936, Pliocene volcanoes of the Navajo-Hopi country: Geol. Soc. Am. Bull., vol. 47, pp. 111-172.

APPENDIX

Samples collected for laboratory analysis, 1951

Sample Number	eU Percent	U Percent	Ash Percent	U in ash Percent	Location and Remarks
BNM-0	0.0026	0.0010			Pumice, mine ca. 5 miles north Grants, N. Mex.
1	0.002	0.001			Bituminous shale, marine Pennsylvanian (Madera fm), 1.9 miles east of Taos-Mora County line on N. Mex. State Hwy. No. 3
2	0.012	0.010			Coyote Mining Dist., Mora County, N. Mex. Carbonaceous shale associated with sandstone-type copper deposit, Sangre de Cristo fm. (Permian)
3	0.006	0.004			Tailings from prospect pit, Coyote Mining Dist.
4	0.010	0.009			Tailings from prospect pit, Coyote Mining Dist.
5	0.003	0.001			Guadalupe mine, Guadalupe Co., N. Mex. Carbonaceous shale associated with sandstone-type copper deposit. Santa Rosa sandstone, Triassic
6	0.002	0.002			Guadalupe mine, carbonaceous material in sandstone
7	Less than .001				Base of Percha shale (Devonian) Alamo Canyon, Otero Co., N. Mex.
8	.004	.002			Calcareous zone in Percha shale, ca. 15 feet above base, Alamo Canyon
9	0.004	0.002			Calcareous zone in Percha shale, ca. 22' above base, Alamo Canyon
10	0.003				Percha shale, Alamo Canyon, Basal 3' of 6' shaly unit
11	0.002				Percha shale, Alamo Canyon, Upper 3' of 6' shaly unit
12	0.001				Percha shale, Alamo Canyon, Nodular unit below contact with Lake Valley limestone (Miss.)
13	0.001				Percha shale, 20' from base, Rhodes Pass, San Andres Mts., Socorro County, N. Mex.
14	0.001				Percha shale, 20' unit above No. 13

Samples collected for laboratory analysis, 1951--Continued

Sample Number	eU Percent	U Percent	Ash Percent	U in ash Percent	Location and Remarks
BNM-15	0.001				Percha shale, 10' unit above No. 14
16	0.002				Calcareous shale, in Lake Valley limestone (Miss.) Rhodes Pass
17	0.002				Carbonaceous shale, Mesaverde fm. (Cret.) ca. 5 miles east of Engle, Sierra Co., N. Mex.
18	0.001	0.001	31.0	0.003	Coal, Mesaverde fm. (Cret.) Lobo Canyon west of Mt. Taylor, Valencia Co., N. Mex.
19	0.002	0.001			Pumice, mine ca. 5 miles north Grants, [illegible] Valencia Co., N. Mex.
20	0.003	0.001			Pumice, mine ca. 5 miles north Grants, N. Mex.
21	0.004	0.002			Clay, playa below pumice mine, 5 miles north Grants, N. Mex.
22	0.002				Carbonaceous shale parting, Dakota sandstone (Cret.), 3 miles north Prewitt, Valencia Co., N. Mex.
23	0.002				Carbonaceous shale parting, Dakota sandstone (Cret.), 5 miles north of Grants, N. Mex.
24	Less than 0.001				Santa Fe fm. (Pliocene), pumiceous, 3 miles south San Ysidro, Sandoval Co., N. Mex.
25	Less than 0.001	.001	33.2	0.004	Coal, Mesaverde fm., San Ysidro coal field, Sandoval Co., N. Mex.
26	0.001	0.001			Clay, overlying No. 25
27	0.002				Shale, overlying No. 26
28	0.004	0.005			Aggregate of rock types, Spanish Queen mine, Abo fm. (Permian), Jemez Canyon, Sandoval Co., N. Mex.
29	0.007	0.006			Carbonaceous shale, Spanish Queen mine
30	0.009	0.009			Carbonaceous shale, Spanish Queen mine
31	0.005	0.006			Sandy carbonaceous shale, Spanish Queen mine
32	0.007	0.009			Copper mineralized zone, Spanish Queen mine

Samples collected for laboratory analysis, 1951--Continued

Sample Number	eU Percent	U Percent	Ash Percent	U in ash Percent	Location and Remarks
BNM-33	0.007	0.008			Copper mineralized zone, Spanish Queen mine
34	0.004	0.003			Copper mineralized zone, Spanish Queen mine
35	0.007	0.009			Carbonaceous shale, outcrop adjacent to Spanish Queen mine
36	0.019	0.015			Pod-like mass, copper mineralized zone, Spanish Queen mine
37	0.006	0.005			Copper mineralized zone, Agua Zarca sandstone (Triassic Senorito Dist., Sandoval Co., N. Mex.
38	0.005	0.005			Copper mineralized zone, Abo fm. (Permian) Piedras Negras Canyon, Sandoval Co., N. Mex.
39	0.002	0.003			Copper mineralized zone, Poleo sandstone (Triassic) Cobre Wash, Rio Arriba Co., N. Mex.
40	0.003	0.002			Carbonaceous shale in Wanakah fm. (Jurassic), Butte 2 1/2 miles south of Coyote, Rio Arriba Co., N. Mex.
41	0.002				Carbonaceous shale in Dakota sandstone (Cret.). San Ysidro coal field, Sandoval Co., N. Mex.
42	0.001	0.001			Carbonaceous shale in Dakota sandstone. Below No. 41

Note: Samples 43-92 included in Trace Elements Investigations Report 241 (Vine, Bachman, Read, Moore)

Sample Number	eU Percent	U Percent	Ash Percent	U in ash Percent	Location and Remarks
93	0.006				Rat excreta associated with Bandelier tuff, Jemez volcanic plateau, Sandoval Co., N. Mex.
94	0.005				Tuff, same locality as No. 93
95	0.006	0.003			Bandelier tuff (Tertiary), Rio Las Vacas Canyon, Sandoval County, N. Mex.
96	0.003	0.003			Bandelier tuff, Jemez Canyon, Sandoval County, N. Mex.

Note: Samples 97-101 included in another report. (Vine, Bachman, Read, Moore).

Samples collected for laboratory analysis, 1951--Continued

Sample Number	eU Percent	U Percent	Ash Percent	U in ash Percent	Location and Remarks
BNM-102	0.010	0.010	45.5	0.021	Coal, Tocito sandstone, (Cret.), Beautiful Mountain, San Juan County, N. Mex.
103	0.006	0.007	56.1	0.013	Coal and bone, Tocito sandstone, Beautiful Mountain
104	0.002	0.002			Iron stained Tocito sandstone, Beautiful Mountain
105	0.002	0.002			Pierre shale (Cret.) associated with basaltic dike, Huerfano County, Colo.
106	0.004	Less than 0.001	93.2	Less than 0.001	Lower 5' of 20' shale in Martin limestone (Devonian) Gila County, Ariz.
107	0.004	Less than 0.001	91.0	Less than 0.001	Second 5' above 106
108	0.003		88.4		Third 5' above No. 107
109	0.004	Less than 0.001	87.8	Less than 0.001	Top 5' above No. 108
110	0.002		91.5		Carbonaceous shale, Cretaceous, Deer Creek coal field, Gila Co., Ariz.
111	0.004	0.002	79.0	0.003	Carbonaceous shale, Cretaceous, Keams Canyon, Navajo Co., Ariz.
112	0.004	0.002	91.5	0.002	Carbonaceous shale and stone above No. 111
113	0.003	0.002	97.8	0.002	Natural ash, upper 1' of 2' Tuba City coal mine, Coconino County, Ariz.
114	0.005	0.001	93.9	0.004	Natural ash, below No. 113
115	0.002	0.001	42.5	0.002	Bony coal 5.5' below No. 114

Geophysical Observations in Parts of the Grants District, McKinley County, New Mexico

Stewart

Declassified 3-10-67

Trace Elements Investigations Report 244

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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Geology - Mineralogy

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UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

GEOPHYSICAL OBSERVATIONS IN PARTS OF THE GRANTS DISTRICT, McKINLEY COUNTY, NEW MEXICO*

By

Kenneth L. Cook and Calvin K. Moss

August 1952

Trace Elements Investigations Report 244

This preliminary report is distributed without editorial and technical review for conformity with official standards and nomenclature. It is not for public inspection or quotation.

*This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission

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GEOPHYSICAL OBSERVATIONS IN PARTS OF THE GRANTS DISTRICT, McKINLEY COUNTY, NEW MEXICO

By

Kenneth L. Cook and Calvin K. Moss

ABSTRACT

Geophysical observations near Haystack Mesa in the Grants district, McKinley County, New Mexico, had the dual objective of investigating the unusual occurrence of negative aeromagnetic anomalies in close association with airborne radioactivity anomalies, and of investigating other geophysical methods which might assist directly or indirectly in the search for uranium ores in the Grants district. Ground magnetometer tests indicate the apparent correlation shown in the airborne data is fortuitous.

Ground magnetometer and self-potential surveys on an experimental basis may be justified to test the applicability of these methods in future exploration. Aeromagnetic surveys would aid field geologic studies in locating concealed Tertiary intrusives, which may have affected ore localization.

Continuation of the airborne radiometric survey of the Todilto limestone outcrop is recommended to search for promising areas that might contain additional deposits.

INTRODUCTION

In a combined airborne radioactivity and aeromagnetic survey in the vicinity of Grants, New Mexico, made by the U. S. Geological Survey on May 28, 1951, an unusual association of radioactivity and negative magnetic anomalies was noted (Stead, 1951). As it was thought that this association might reflect a genetic relationship between the uranium mineralization and the geologic structure causing the negative magnetic effect, further investigation seemed advisable.

On December 12 and 13, 1951, field examinations were made in secs. 19 and 25, T. 13 N., R. 10 W., N. M. B. and P. M., McKinley County, New Mexico. Brief ground magnetometer tests were also made in sec. 19. The magnetometer test area lies about 1 mile south of Haystack Mesa, about 6 miles north-northeast of the village of Bluewater (Bluewater lies about 12 miles northwest of the city of Grants), or about 20 miles northwest of Mount Taylor. Section 25 lies about 6 miles east-southeast of Haystack Mesa, about 9 miles northeast of the village of Bluewater, or about 15 miles northwest of Mount Taylor.

The field examinations had the dual purpose of investigating by geologic and ground magnetometer traverses the unusual occurrence of the observed negative magnetic anomalies in close association with observed radioactivity anomalies, and of investigating the possibility that other geophysical methods, in addition to the standard radioactive method already employed, might offer some additional help, either directly or indirectly, in the search for uranium ore in progress in the Grants district.

The writer wishes to thank Mr. Irving Rapaport of the Atomic Energy Commission and his staff for their cooperation and help given in several conferences during the field tests and examinations. The work upon which this report is based was done on behalf of the Atomic Energy Commission.

GENERAL GEOLOGIC RELATIONSHIPS

The Grants district lies along the northern flank of the Zuni Uplift which is a northwestward-trending dome of early Tertiary age covering approximately 2,000 square miles (Towle and Rapaport, 1952). Sedimentary rocks of Jurassic and Cretaceous age are exposed in or near the area in which the field examinations were made. In sec. 19, where the magnetometer tests were made, are the volcanic cone El Tintero (fig. 1) and an extensive lava bed that extends southward to the village of Bluewater. Mount Taylor lies about 20 miles southeast of El Tintero. Hunt (1938, p. 73) describes the area north of Bluewater, which includes the El Tintero cone area, as follows:

> Very recent flows of basalt are found in the valley of the Rio San Jose along the south border of the (Mount Taylor) volcanic field. These flows were given only casual attention, because none were supplied by vents within the (Mount Taylor) field. Some of the vents are along the east side of the Zuni Mountains, others are north of the village of Bluewater, and others are near Laguna Pueblo. The flows have exceedingly fresh surfaces, which, combined with their position in the valley bottom, make them appear as if they had been flowing only yesterday. These flows are more ferromagnesian than most of the sheet eruptives of the Mount Taylor volcanic field. They consist of labradorite with a high percentage of olivine, slightly less augite, and some magnetite.

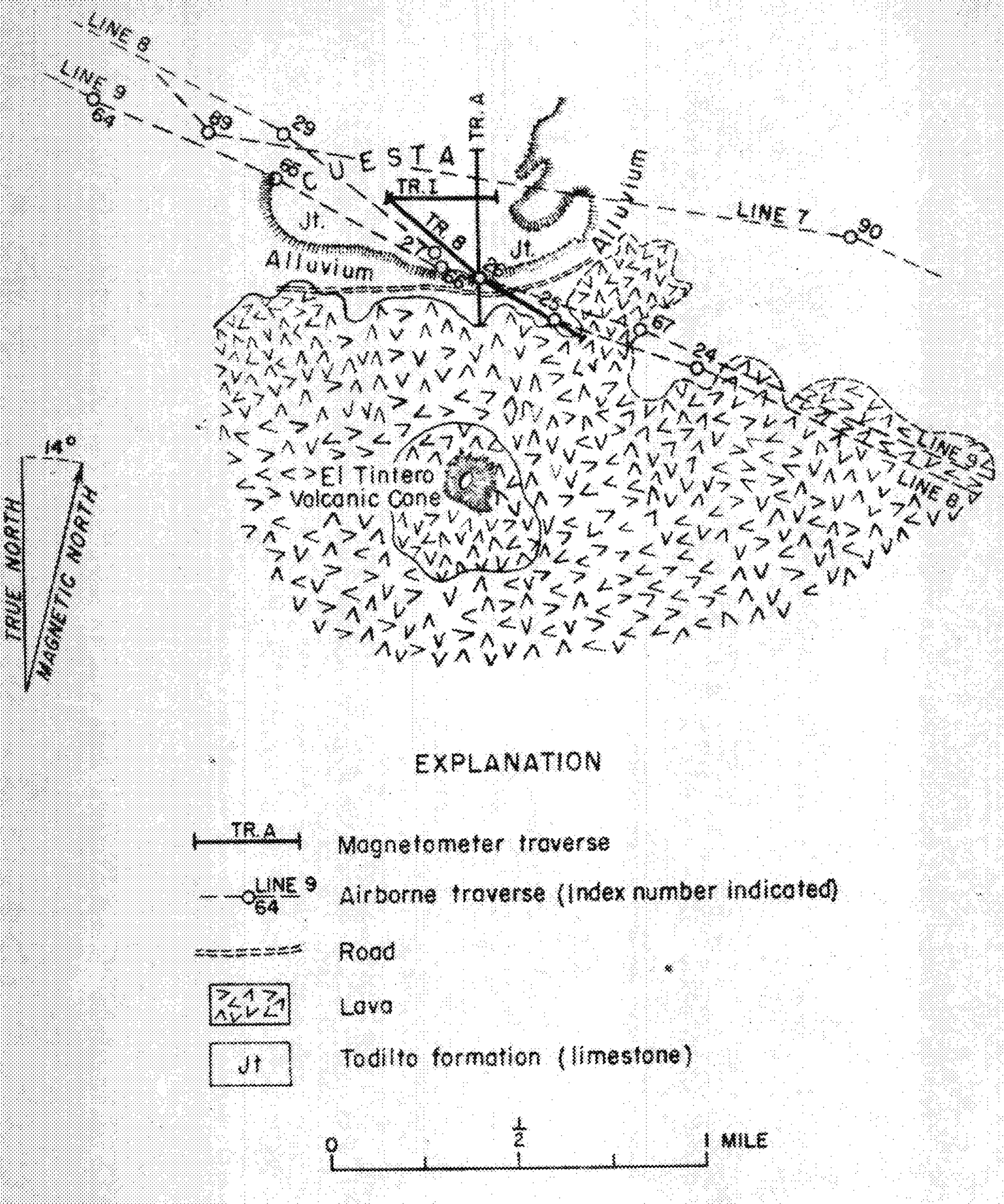

Figure I. - Map of surveyed area, near Grants, New Mexico - 1952.

COMPILED FROM AIR PHOTO

In the test area in sec. 19 the prominent geologic features are: (1) the red southward-facing cliff of Entrada sandstone capped with Todilto limestone, which forms a bench or cuesta extending to the north away from the cliff and (2) El Tintero volcanic cone (figs. 1 and 2). Exposures of the lava bed extend northward from El Tintero to within about 500 feet of the south face of the cliff (fig. 1). A mantle of alluvium, probably between 2 and 5 feet in average thickness, covers the Todilto limestone. Except at or near the edge of the cliff, the alluvium is probably sufficiently thick to mask completely the radioactivity of the ore within the Todilto limestone. At least locally in this area the alluvium or residual soil apparently contains some radioactive minerals.

Uranium deposits

The tests and field examinations discussed in this report were confined solely to the ore deposits in the Todilto limestone, which is the principal ore horizon in the Grants district.

Uranium deposits of the Grants district are described by Towle and Rapaport (1952) as follows:

> .....Irregular, blanket-type uranium deposits are in terrestrial Jurassic sediments. The principal ore-horizon is the upper recrystallized portion of the Todilto limestone. This limestone erodes as benches one-half to three miles wide, enabling relatively cheap exploration and open-pit mining. Ore deposits have also been discovered in the sand lenses of the Morrison formation, 500 to 800 feet stratigraphically above the Todilto. The Morrison erodes into steep cliffs, necessitating more expensive exploration and mining methods.

> The uranium minerals in the Todilto are carnotite, tyuyamunite, and uranophane; finely disseminated pitchblende is found where the deposits are removed from the effects of superficial oxidation. Gangue minerals are pyrite, hematite, calcite, and traces of barite and fluorite. The sandstone ores in the Morrison contain carnotite and schroeckingerite, associated with limonite and organic material. The ore deposits are believed to have achieved their present form by the lateral percolation of slightly heated Tertiary waters. Uranium, however, may have originally been contributed during the Jurassic.

According to J. W. Gruner (personal communication from I. Rapaport), hematite existing as a pseudomorphic replacement of pyrite is associated with the uranium minerals in sec. 19. Because of this replacement the ore is now impoverished of pyrite and relatively enriched with hematite.

In sec. 25, however, a normal amount of pyrite is found in the uranium ore, as replacement of the pyrite by hematite has not occurred to any considerable extent (personal communication from I. Rapaport). The "normal" amount of pyrite is probably considerably less than 1 percent in terms of percentage of the rock volume.

To the geophysicist, the problem of whether the uranium deposits may be genetically related to dikes, known to exist in the Grants district, is of paramount importance principally because the discovery of the dikes is possibly amenable to geophysical methods.

According to Rapaport (personal communication), however, no genetic relationship between the dikes and the ore bodies is known. He stated further that in the Laguna area, east of Grants, good exposures of dikes which cut the uranium bodies were found, thus indicating that some of the dikes are older than the uranium bodies.

INSTRUMENT AND FIELD TECHNIQUES

A standard, temperature-compensated Askania vertical magnetometer with a sensitivity of 29 gammas per scale division was used for the ground surveys. Three traverses were made: one insofar as possible directly below airborne line 8 (Traverse 8); one trending north from the north edge of the lava, up and over the south face of the cliff, and approximately 1,600 feet along the Todilto limestone bench (Traverse A); and a third over a uranium body (Traverse I). About 140 magnetometer stations were occupied in a total traverse distance of about 7,500 feet. The magnetometer observations were made generally at 20- or 25-foot intervals over exposed lava beds or in areas of steep magnetic gradients, at 25- or 50-foot intervals over mineralized areas, and at 100- to 200-foot intervals over unmineralized areas or areas of gentle magnetic gradients. Distances along traverses were measured with a cloth tape.

The ground magnetometer traverses within the area of the Atchison, Topeka and Santa Fe Railway grid system were tied to this grid. The traverses beyond the area of this grid system were tied to conspicuous features on the ground, such as roads, cliffs, El Tintero volcanic cone, and isolated trees, which were plainly visible on the aerial photograph (approximate scale of the aerial photograph: 1.85 inch equals 1 mile).

MAGNETIC OBSERVATIONS

Ground magnetometer traverse 8 is characterized by a gradual decrease in vertical magnetic intensity southeastward across the bench or cuesta toward the cliff, a minimum of about 1,400 gammas near 200E (about 250 feet south of the edge of the cliff) accompanied by a small maximum near 375E, and a highly irregular intensity pattern for the remainder of the traverse (fig. 3).

The irregular magnetic intensity pattern southeast of 375E is probably caused by lava lying immediately beneath the thin mantle of alluvium. Lava is exposed in some places along traverse 8 southeast of the road, and probably extends northwestward beneath the alluvium at least as far as 375E.

The negative anomaly at 200E may be caused by a dike, with inverse remanent magnetization, or, equally plausibly, the negative anomaly may be the magnetic manifestation of the northwest edge of the lava bed. Small pieces of lava float were tested and found to reveal strong remanent magnetization, but no oriented specimens from outcrops were taken.

The aeromagnetic anomaly can be correlated reasonably well with the ground magnetic anomaly. The minimum of the aeromagnetic anomaly (fig. 3), which is about 600 gammas in magnitude, lies about 230 feet northwest of the minimum of the ground magnetic anomaly. The offset is probably caused largely by either errors of location or instrumental lag, or a combination of these factors; the amount of offset lies within the margin of location error for airborne surveys. As the airborne measurements are of total intensity measured from an arbitrary datum, there can be no direct comparison with the magnitude of ground measurements of vertical intensity.

The airborne radioactivity maximum (fig. 3), located at about 1030W, lies over or close to areas where uranium minerals are known to occur at shallow depths in the limestone forming the top of the cuesta. The radioactivity peak lies about 1,000 feet northwest of the aeromagnetic minimum and about 1,230 feet northwest of the ground magnetic minimum.

The general pattern of the magnetic profile of traverse A (fig. 4) is somewhat similar to that of traverse 8. Southward over the Todilto bench, the vertical magnetic intensity decreases and reaches a minimum of about 1,800 gammas at 150N, about 250 feet south of the edge of the cliff, then increases in magnitude to station 75N, where an irregular intensity pattern begins and persists to the south over the lava bed. The irregular intensity values indicate that the lava extends north at least as far as about 75N. As before, the negative center is due either to an inversely magnetized dike or is the magnetic manifestation of the north edge of the lava bed.

The trend of the magnetic negative anomaly, as sketched on figure 2 on the basis of traverses 8 and A only, is approximately east-northeast or parallel to the face of the cliff. The data are insufficient to interpret confidently the significance of the magnetic trend.

Ground magnetometer traverse I (fig. 5) was taken over a uranium body. There are slightly anomalous magnetic intensities in places on this traverse, but any interpretation of them is inconclusive because of the broken drill rods that were left in at least one of the many drill holes along the traverse.

CONCLUSIONS

The results of the ground magnetometer tests indicate that the apparent correlation between the negative aeromagnetic anomaly and the positive airborne radioactivity anomaly is probably fortuitous and cannot be attributed to a genetic relationship between uranium mineralization and the intrusion of dikes or the extrusion of the basaltic lava flow.

REFERENCES CITED

Hunt, C. B., 1938, Igneous geology and structure of the Mount Taylor Volcanic Field, New Mexico: U. S. Geol. Survey Prof. Paper 189-B, p. 73, and Plate 7.

Stead, F. W., 1951, Airborne radioactive survey in the vicinity of Grants, McKinley and Valencia Counties, New Mexico: U. S. Geol. Survey Trace Elements Memorandum Rept. 161, unpublished, pp. 1-13.

Towle, C. C., and Rapaport, I.. 1952, Uranium deposits of the Grants district, New Mexico, A.I.M.E. Mining, Geology and Geophysics Division, Abstract of Technical Papers, 1952 Annual Meeting, abstract only, p. 19.

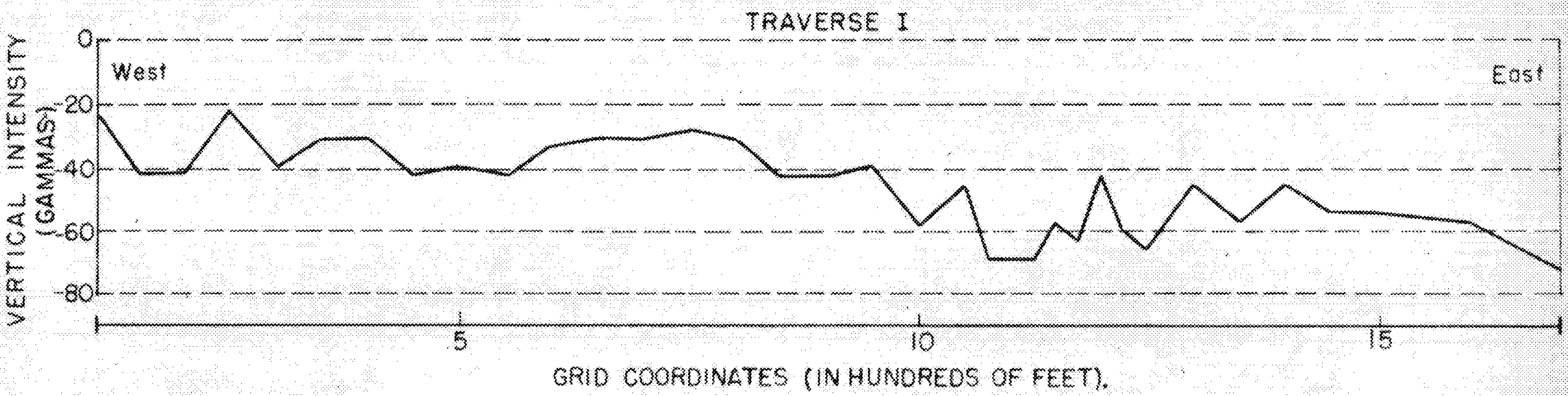

Figure 5. - Magnetic profile along Traverse I.

USGS TEIR-244, Part II

RECOMMENDATIONS

The existence of hematite in the ore and especially the shallow depth of the ore may justify some ground magnetometer surveys of an exploratory nature in the future. Magnetometer tests should be made first in a drilled-out area where lost tools have been carefully recorded, to ascertain whether recognizable magnetic anomalies exist over or adjacent to the uranium ore. Such magnetometer tests should be made first in sec. 19, where more hematite exists, and next in sec. 25. Unless recognizable magnetic anomalies over or adjacent to the ore are firmly established, no extensive ground magnetometer exploration will be justified. The experimental work discussed is not included in current Survey plans, but it will be considered if the Commission so requests.

Towle and Rapaport have suggested that the ore deposits have achieved their present form by the lateral percolation of slightly heated Tertiary waters. If this is true the location of concealed Tertiary intrusives might help to indicate the probable sources of the heat and the direction of migration of the waters. Airborne magnetic surveys would aid greatly in locating such intrusives; and, if the Commission wishes, the Survey will consider undertaking such surveys.

To date all large airborne radioactive anomalies found over the Todilto limestone can be corelated with the occurrence of uranium minerals in the ground. Airborne radioactive anomalies found occasionally over the lava beds are apparently not as diagnostic, however, as they may be the cumulative effect of widespread traces of radioactive material. In many places the mantle of alluvium masks the radioactive effect of uranium-bearing bedrock, and uranium ore bodies, without accompanying airborne radioactive anomalies, have been found (personal communication from I. Rapaport).

Continuation of the airborne radiometric survey of the outcrop of the Todilto, completed thus far only in the Grants district, is recommended on a regional scale to outline promising areas that might contain additional deposits. Such a survey would cost about $15,000, and if approved by the Commission, might be undertaken by the Survey in the 1953 field season.

Brief experimental self-potential traverses probably should be made to determine whether or not this method can be applied to the Grants-type deposits in future exploration. The electrical tests should be made preferably in the early spring when the moist ground will afford better contact for the nonpolarizing electrodes. The probable great depth to the ground water table, the small percentage of pyrite, and other factors diminish the likelihood that substantial, consistent, self-potential anomalies will be found associated with the ores. The shallow depth of the ore and the presence of pyrite, however, seem to justify at least some brief experimental electrical tests. None are planned now but they will be considered if the Commission desires.

Airborne Radioactivity Survey in the Vicinity of Grants, McKinley and Valencia Counties, New Mexico

Trace Elements Memorandum Report 161

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UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

AIRBORNE RADIOACTIVITY SURVEY IN THE VICINITY OF GRANTS, McKINLEY AND VALENCIA COUNTIES, NEW MEXICO

by

Frank W. Stead

July 1951

Trace Elements Memorandum Report 161

USGS - TEM Report 161

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(In envelope)

AIRBORNE RADIOACTIVITY SURVEY IN THE VICINITY OF GRANTS, McKINLEY AND VALENCIA COUNTIES, NEW MEXICO

by

Frank W. Stead

ABSTRACT

An airborne radioactivity survey in the vicinity of Grants, New Mexico, was made on May 28, 1951; aeromagnetic measurements were made concurrently with the radioactivity measurements. Several radioactivity anomalies were noted in conjunction with negative magnetic anomalies; this association is unusual and may reflect a genetic relationship between the uranium mineralization and the geologic structure causing the negative magnetic effect. Further investigation of the vicinity of the anomalies near the Haystack area, including a ground magnetometer survey, seems warranted.

INTRODUCTION

The airborne radioactivity survey in the vicinity of Grants, New Mexico, was made on May 28, 1951, as a part of a cooperative program with the U. S. Atomic Energy Commission. The accompanying map, figure 1, shows the location of the radioactivity and aeromagnetic anomalies over an area of about 45 square miles.

The survey was made by Geiger-counter and scintillation-counter equipment mounted in a Douglas DC-3A aircraft. Aeromagnetic measurements were made concurrently with the radioactivity measurements. All traverses were flown at a nominal 500-foot flight level at quarter-mile intervals. Aerial photographs were used for pilot guidance, and the flight path of the aircraft was recorded by a gyrostabilized continuous strip-film camera. The distance of the aircraft from the ground was measured with a continuously recording radar altimeter. A total of 2½ hours were spent in actual surveying. Approximately 300 miles of traverse were flown.

The flight lines in the area, shown on figure 1, were oriented to give the maximum coverage of the outcrop of the Todilto limestone of Jurassic age with the objectives of determining the response of the radiation detection equipment over known radioactive mineralization and of locating other radioactive deposits in the general vicinity. One flight line, the extension of line 7 westward along the outcrop of Todilto limestone to near Gallup, New Mexico, has not been plotted on a base map as no anomalies were found along that flight line.

RADIOACTIVITY MEASUREMENTS

All radioactivity measurements were made approximately 500 feet above the ground by: (1) a dual channel radiation detector employing

19 2 by 42-inch Geiger counters; and (2) a scintillation detector employing 4-inch diameter by 2-inch thick sodium iodide crystals.

The dual-channel radiation detector has two output channels, the C channel and the T-C channel. The C channel records the multiple or coincidence pulses originating from hard cosmic radiation striking the bundle of counters; the T-C channel records the anti-coincidence pulses or the total counting rate minus the coincidence counting rate. A portion of the record for the T-C channel is shown in figure 2 A where the average counting rate is roughly 300 counts per second at 40 divisions on the E-A tape. The time constant of the T-C channel of the dual-channel radiation detector, with a standard counting-rate meter output, is one second.

The scintillation detector consists of the 4-inch sodium iodide crystals as the radiation detector proper, a pre-amplifier, a linear amplifier and discriminator, and a modified counting-rate meter. The only unusual feature is the modified counting-rate meter which records automatically alternate one-second measurements from two identical output stages; thus, each channel accumulates pulses for one second and records that measurement in the following second to complete the cycle. Thus, the output of the modified counting-rate meter is comparable to that of a scaler for a one-second period of measurement, an improvement over the slower and more complex response of a standard counting-rate meter with a one-second time constant.

The automatic correction of the radiation measurements for variation in distance of the aircraft from the ground, achieved by utilizing the radar altimeter output to modify the counting-rate meter output, was applied only to the modified counting-rate meter of the scintillation detection equipment; it was not applied to the dual-channel radiation detector. Using this correction, an anomaly will maintain the same apparent amplitude when measured between 250 and 1,000 feet above the source, although the statistical fluctuation of the measurements becomes larger with increase in distance from the source.

During the survey, the Geiger counters were connected through a pre-amplifier to: (1) the dual-channel radiation detector (T-C channel); and (2) one of the modified counting-rate meters of the scintillation detection equipment whose output was also corrected for distance from source. Comparison of figures 2 A and 2 B shows the gain in resolution of the modified counting-rate meter with a one-second period of measurement, where the standard deviation would be $\sqrt{N}$, over the typical counting-rate meter of the dual-channel radiation detector with a one-second time constant, where the standard deviation would be $\sqrt{2NXTC}$.

A Halross Model 939 Scintillometer was carried during the survey and by visual comparison with the records of the other equipment was found to be relatively sluggish and insensitive.

Measurements of total magnetic intensity were made simultaneously with the radioactivity measurements, using a Model ASQ-3A airborne magnetometer.

Extent of coverage

At a nominal 500-foot flight level, the width of the zone from which the radioactivity is measured is at least 1,400 feet. Thus, at quarter-mile spacing of flight lines or 1,320-foot intervals, the entire area should be covered adequately. During this particular survey, deviations from planned parallel flight lines were made on lines 6, 7, 8, and 9 to avoid topographic highs where the Todilto outcrop was lacking. It is possible that small areas of considerable activity midway between flight lines 6 and 7 may not have been noted.

Location of anomalies

The approximate location of each radioactivity and magnetic anomaly is shown on figure 1 by appropriate symbols. The compilation and plotting of data _/ require the assumption of straight-line flight

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_/ Jensen, Homer, and Balsley, J. R., Jr., Controlling plane position in aerial magnetic surveying: Eng. & Min. Jour., vol. 147, no. 8, pp. 94-95, 153-154, August 1946.

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and constant ground speed between recognizable positions plotted on the maps; thus, if the distance between such points is large, the error in estimated position midway between the points may be considerable. In this survey, the location of anomalies, as shown on figure 1, is correct within 300 feet; more precise plotting is not possible due to inaccuracies in the base map of that order of magnitude.

RADIOACTIVITY AND MAGNETIC ANOMALIES

The radioactivity and magnetic anomalies recorded during the survey are listed in table 1 and are shown on figure 1 by appropriate symbols. Small changes in radiation intensity occurring over a flight distance of more than 1 mile (24 seconds average flying time) probably reflect a characteristic of the soil mantle or formations exposed at the surface and have not been shown as anomalies.

The pertinent E-A records for the anomalies of greatest interest near the Haystack area in Sec. 19, T. 13 N., R. 10 W., are shown in figures 2 A, 2 B, 2 C, and 2 D. The records for the scintillation detector during this particular survey were essentially valueless due to excessive noise in the amplifier and were used solely as a confirmation of anomalies recorded by the dual-channel radiation detector.

Figure 2 A is the E-A record of the Geiger counters from the T-C channel of the dual-channel radiation detector and is uncorrected for variation in distance from ground. The counting rate at 40 divisions is approximately 300 counts per second with a one-second time constant;

Table 1

Radioactivity and Aeromagnetic Anomalies

Flight line	Location of radioactivity anomaly 1/	Location of aeromagnetic anomaly 1/
4	No. 1254.8S 2/	
5	No. 1301.5S	
	No. 1303.6S	
7	No. 1380.7S	
	No. 1389.4M	No. 1389.7
8	No. 1426.5L	No. 1426.0 3/
	No. 1430.2M	
	No. 1439S	
9	No. 1456S	
	No. 1466.3L	No. 1466.2 3/

1/ Location designated by serial number on strip photograph and by corresponding edge marks on other records; on figure 1 the first two numbers have been dropped to avoid 5 digit numbers.

2/ S, M, L after number denote respectively small, medium and large radioactivity anomalies.

3/ Magnetic anomalies on lines 8 and 9 occur so close together due to overlapping of flight paths that they are plotted as one anomaly on figure 1.

thus, the standard deviation of measurement is slightly less than 3 divisions on the E-A tape. The large anomaly at 1426.5 is roughly 8 times the standard deviation of the general background counting rate; the medium anomaly at 1430 is roughly 3 times the standard deviation.

Figure 2 B is the E-A record of the Geiger counters connected to the modified counting-rate meter including automatic correction for distance from the outcrop. The counting rate at 10 divisions on the E-A tape is roughly 300 counts per second, the same as for the dual-channel radiation detector, but the measurement reflects a one-second period in which the pulses are accumulated as in a standard scaler rather than a one-second time constant. The standard deviation for each one-second period is the square root of the total events in that second. Comparison of figures 2 A and 2 B shows the advantage of sharpening the resolution of measurement; the anomalies in 2 B are considerably easier to interpret than those in 2 A.

Figure 2 C is the radar altimeter record. The distance from the ground for the large anomaly at No. 1426.5 was 400 feet and for the anomaly at No. 1430 was also 400 feet.

Figure 2 D is the E-A tape for the magnetic airborne detector where the full-scale deflection was 200 gammas; thus, several scale shifts were made to obtain a complete record of the negative anomaly whose minimum was at No. 1426. It will be noted that the large radioactivity anomaly at No. 1426.5 is almost coincident with the sharp negative magnetic anomaly, in excess of 500 gammas, at No. 1426.

The significantportions of magnetic measurements have been rectified and are shown as magnetic profiles for flight lines 7, 8, and 9 in figures 3, 4, and 5 respectively. Rectification of measurement here includes changing to rectilinear coordinates and adjusting the horizontal scale to 1 inch to the mile and the vertical scale to 1 inch equals 160 gammas.

Interpretation of anomalies

The interpretation of the radioactivity anomalies is relatively straightforward as nearly all the anomalies can be directly related to ground areas where present exploration is underway. Exceptions are anomalies No. 1380.7 on line 7, No. 1439 on line 8, and No. 1456 on line 9 that, from examination of the strip photograph, do not appear to be related to any present exploration. However, these anomalies are all small and may represent no more than small local areas in which the general level of radioactivity is several times normal, a not unusual variation in background.

In the vicinity of the Haystack area, Sec. 19, T. 13 N., R. 10 W., the almost coincident occurrence of medium and large radioactivity anomalies with sharp negative magnetic anomalies is highly unusual.

Although the relationship may be one of chance, the two cases separated by 0.7 miles suggest a possible genetic relationship rather than an accidental relationship. The negative magnetic anomaly may reflect a diabase dike or plug with inverse remanent magnetization; thus, the uranium mineralization in the Todilto limestone may be hydrothermal (?) and genetically related to a buried diabase dike or plug which was the source, or channelway, for the mineralizing solutions. The nearby presence of a volcanic cone one mile to the south of the Haystack area lends credence to this possibility.

The negative magnetic anomaly, No. 1426 on line 8 and shown on the magnetic profile in figure 4, is in excess of 500 gammas and should be several thousand gammas if measured on the ground.

CONCLUSIONS

The occurrence of negative magnetic anomalies in close association with radioactivity anomalies known to represent uranium mineralization of commercial importance is sufficiently unusual to warrant further investigation. A ground magnetometer survey, properly coordinated with all available geologic data, is recommended in the Haystack area. Should such an investigation demonstrate any genetic relationship between uranium mineralization and the geologic structure causing the negative magnetic anomalies, further consideration might be given to a more comprehensive radioactivity-aeromagnetic survey of the surrounding region.

8

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

August 27, 1954.

Memorandum

To: Secretary to the Operating Committee, DMEA

From: Executive Officer, DMEA Field Team, Region IV

Subject: Docket No. DMEA-3152 (Uranium), Hanosh Mines, Inc., McKinley County, New Mexico.

Enclosed are four copies of the report of field examination on the subject application and two copies of Form 3b.

This docket has been closed by this office effective August 16, 1954 because the applicant has not provided an approved Assignment of Lease.

WH King
W. H. King

Enclosures

RDB:cwm

cc: Docket
Administrator, DMEA
WMTraver
Arnold Brokaw
AHKoschmann
Chron.

Reviewed by
DMEA OPERATING COMMITTEE
9-3-54
(date)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Mining Division
Region IV

March 3, 1954.

Memorandum

To: Field Team, Region IV

From: Chief, Mining Division, Region IV

Subject: Report of Examination - DMEA Docket 3152 (Uranium), Hanosh Mines, Inc., McKinley County, New Mexico.

Enclosed are eleven copies of the engineering report of examination on the subject docket.

The applicant requested $26,460.69 to drill the property on a scale which appears to be too ambitious to the examining engineer.

The examining engineer recommends a drilling program to be divided into three stages, the work to consist of 342 holes averaging 40.5 feet in depth at an estimated total cost of $13,851.00.

We concur in this recommendation.

W H King

W. H. King

Enclosures

Reviewed by
DMEA OPERATING COMMITTEE
9-3-54
(date)

February 1?, 1954

Memorandum

To : W. H. King, Chief, Mining Division, Region IV

From : Chief, Mining Methods Br., Mining Div., Region IV

Subject : Engineering Report on Docket DMEA-3152, Hanosh Mines, Inc., Uranium Property, McKinley County, N. Mex.

Enclosed are original and 9 copies of a revised report by Lloyd L. Farnham of the Bureau of Mines on the above property. The other copy will be forwarded to you by R. P. Fischer of the Geological Survey's Grand Junction office. J. D. Strobell of the Geological Survey has read and approved this report by Farnham.

The DMEA field examiners recommend that Hanosh Mines, Inc. be granted exploration assistance to drill its property north of Grants, N. Mex. I concur with this recommendation.

Walter R. Storms

Walter R. Storms

CC W. H. King (10)
R. P. Fischer
DMEA-3152
DF

WRStorms:frj

Reviewed by
DMEA OPERATING COMMITTEE
9-3-54
(date)

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Defense Minerals Exploration Administration
Denver Federal Center
Denver 2, Colorado

February 23, 1954

Memorandum

To: DMEA Field Team, Region IV

From: A. H. Koschmann

Subject: DMEA Docket 3152, Hanosh Mines, Inc., McKinley County, New Mexico

Enclosed are 11 copies of a geologic report by J. D. Strobell, Jr., of the U. S. Geological Survey covering the above docket.

The recommended plan of exploration has been revised to agree with that suggested by Lloyd Farnham of the Bureau of Mines office in Tucson, as requested by the Field Team in December.

A. H. Koschmann

A. H. Koschmann
Supervising Geologist
Colorado-Wyoming

Enclosures (11)

Reviewed by
DMEA OPERATING COMMITTEE
9-3-54
(date)

C
O
P
Y

UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey
P. O. Box 360
Grand Junction, Colo.

February 24, 1954.

Memorandum

To: W. H. King, DMEA Field Team, Region IV

From: R. P. Fischer, Colorado Plateau District

Subject: DMEA 3152, Hanosh Mines, Inc., Uranium Property, McKinley County, New Mexico.

Forwarded herewith is carbon copy of Farnham's report, DMEA 3152, Hanosh Mines, Inc., Uranium Property, McKinley County, New Mexico, as requested by Storms in his memorandum of February 17.

/s/ R. P. Fischer
District Supervisor

Enclosure

Reviewed by
DMEA OPERATING COMMITTEE
9-3-54
(date)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

P. O. Box 360
Grand Junction, Colo.

February 19, 1954

Memorandum

To: A. H. Koschmann, Field Team, Region IV

From: R. P. Fischer, Supervisor, Colorado Plateau District RPF

Subject: DMEA 3152, Hanosh Mines, Inc., McKinley County, New Mexico

Transmitted herewith are 11 copies of Strobell's revised report on the above application. The recommended plan of exploration has been revised to agree with that suggested by Lloyd Farnham of the Bureau of Mines office in Tucson, as requested by the Field Team in December.

Enclosures 11

JDS/mlr

cc: A. H. Koschmann (1 extra)
W. H. King
W. R. Storms

Reviewed by
DMEA OPERATING COMMITTEE
9-3-54
(date)

ED_006270_00000674-00085

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
P. O. BOX 360
GRAND JUNCTION, COLORADO

October 9, 1953

Memorandum

To: A. H. Koschmann, DMEA Field Team, Region IV

From: R. P. Fischer, Acting Supervisor
Colorado Plateau District

Subject: DMEA 3152, Hanosh Mines, Inc., McKinley County, New Mexico

Transmitted herewith are eleven copies of a geologic report on the ground leased by the Hanosh Mines, Inc., McKinley County, N. Mex. The company applied for assistance in exploring for uranium; they propose to do 30,410 feet of drilling and related work at an estimated cost of $26,460.69.

The attached report is prepared by J. D. Strobell, Jr., and is based on a joint field examination on September 15 with Lloyd Farnham, USBM, and Irving Rapaport, representing the applicants. The examining team also conferred with P. E. Melancon, AEC geologist, who is in general agreement with the conclusions and recommendations offered in the report.

Strobell concludes that exploration in the area has a good chance of finding 6,000 to 9,000 tons of ore, and thus is favorable for exploration. On this basis, he recommends an exploration contract, pointing out at the same time, however, that the value of the ore expected probably will not be sufficient to repay through royalty payments the entire cost to the government. A program of ~~15,000~~ 13,851 feet of drilling, smaller than that proposed by the applicant, is suggested.

I concur with these conclusions and the suggested plan of exploration.

R. P. Fischer

R. P. Fischer
Acting District Supervisor

Reviewed by
DMEA OPERATING COMMITTEE
9-3-54
(date)

Enclosures 11

RPF/mlr

ED_006270_00000674-00086

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

In August 1953, Hanosh Mines, Inc. applied to the Defense Minerals Exploration Administration, under the Defense Production Act of 1950, as amended, for an exploration loan amounting to $26,460.69. The application was docketed as DMEA-3152. The funds requested were to be used in the exploratory drilling of a uranium prospect situated in the Grants district of northwestern New Mexico. The property was examined 1/ on September 15, 1953.

Extensive exploration has been under way in the Grants region since 1950 when the presence of uranium first was detected. The deposits occur as sporadic, irregular, blanket-type replacements in the Todilto limestone and also in some of the overlying formations. The Todilto in the Grants area is a persistent gently dipping (4^{o}) bed about 20 feet in thickness which owing to its relative resistance to erosion, usually caps many of the lower benches and mesas along the valley floors.

The project property covers an unexplored area of about 43 acres that is underlain by this ore-bearing limestone. Except in the immediate vicinity of the outcrop the favorable bed is usually completely covered with varying amounts of soil and younger sediments, which increase progressively in thickness down the dip of the limestone. This mantle of overburden not only covers the area proposed for exploration but prevails generally throughout the district. Structural controls or other ore-guides usually are lacking so that closely spaced

1/ Farnham, L. L., Mining Engineer, Bureau of Mines;
Strobell, J. D., Geologist, Geological Survey

Reviewed by
DMEA OPERATING COMMITTEE
9-3-54
(date)

blind drilling has been, and still is the only practical means of discovering ore in the district. Exploratory drilling of this nature has found important, but sporadic ore bodies occupying an irregular belt that extends for about 3 miles to the southeast and for some 4 miles west of the subject property.

The applicant proposed to explore the 43-acre tract by 30,410 feet of rotary drilling in 706 holes, spaced from 100 to 25 feet apart. This work was estimated to cost $26,460.69. As this amount of drilling appeared excessive for the purpose of exploration, an alternative program was recommended which involved 13,850 feet of drilling in 342 holes at an estimated cost of $14,500.

The area proposed for exploration is favorably situated in respect to a productive trend and for that reason it appears to be worthy of exploration. Therefore, it is recommended that a loan amounting to not more than $14,500 be approved.

UNITED STATES DEPARTMENT OF THE INTERIOR
DOUGLAS McKAY, SECRETARY

DEFENSE MINERALS EXPLORATION ADMINISTRATION

REPORT OF EXAMINATION BY FIELD TEAM
REGION IV

DMEA 3152, Hanosh Mines, Inc.,

Section 22, T. 13 N., R. 10 W., Grants District,

McKinley County, New Mexico

Uranium

Geologic report

J. D. Strobell, Jr., Geologist
U. S. Geological Survey

October 9, 1953

Reviewed by
DMEA OPERATING COMMITTEE
9-3-54
(date)

HANOSH MINES, INC.,
McKINLEY COUNTY, NEW MEXICO

INTRODUCTION AND SUMMARY

Application has been made by Hanosh Mines, Inc., for government assistance (DMEA 3152) in exploring for uranium in the Todilto limestone of the Grants District, McKinley County, N. Mex. The applicant proposes 30,410 feet of drilling, at an estimated cost of $26,460.69, to explore about 45 acres in the NE $\frac{1}{4}$, sec. 22, T. 13 N., R. 10 W. The property was examined on September 15, by Lloyd Farnham of the U. S. Bureau of Mines, Tucson, Ariz., and J. D. Strobell, Jr., of the U. S. Geological Survey, Grand Junction, Colo. The examiners were accompanied by the applicant's representative, Mr. Irving Rapaport, and conferred also with Mr. P. E. Melancon, District Geologist of the U. S. Atomic Energy Commission, Grants, N. Mex.

The property lies on allotted Indian lands. Prospecting and mining rights are leased to the applicant with the approval and under the general supervision of the Bureau of Indian Affairs, U. S. Department of the Interior. Royalties stipulated by that Bureau range from 10 to 20 percent of the mine value of the ore (excluding allowances for development and transportation) and include in addition 10 percent of any bonuses paid by the U. S. Atomic Energy Commission.

A somewhat curtailed program (about 50 percent reduction) to explore this property with government assistance is recommended. The applicant's proposal is considered to carry the exploration too far into the development phase not appropriately a part of DMEA exploration. A maximum of ~~15,000~~ 13,851 feet of drilling in primary and offset holes is recommended. It is also suggested that in addition to the radiometric logging of these holes proposed by the applicant, collection of cuttings from the limestone be required until such time as the reliability of radiometric logging is definitely established in the district.

GEOLOGY

In the Grants district, uranium deposits occur in the Todilto limestone and Morrison sandstone beds of Jurassic age, and in the overlying Cretaceous rocks. The Hanosh lease in sec. 22 covers an area underlain by the Todilto limestone. The Todilto caps cliffs of the underlying Entrada sandstone and forms a broad bench where the overlying Summerville formation has been removed by erosion. It dips very gently northeastward across the property and is covered by a veneer of dune sand and alluvium up to about 50 feet thick, which may also locally conceal remnants of the Summerville formation. Except along the rim at the top of the Entrada cliff, the limestone is completely covered on the Hanosh property. Near the northern edge of the property increasing amounts of the silty sandstone of the Summerville formation are likely to be present. The limestone is about 20 feet thick on the average, and the applicant states that the overburden on the property averages only 18 feet in thickness.

ORE DEPOSITS

In the Grants district, uraniferous minerals locally coat bedding planes and joint surfaces of the limestone, are disseminated in blebs and crystals, and are associated with coarsely crystalline carbonates in veinlets. Among the important ore minerals are tyuyamunite, carnotite, uranophane, and uraninite. These minerals are locally present in sufficient amounts to form ore bodies of irregular plan and thickness without sharply defined limits. Controls of their localization are not well understood. The ore bodies occur at all positions between the top and bottom of the limestone. There is evidence of their localization along the axial portion of minor folds, but not all such folds are mineralized. This produces elongated ore bodies, as does localization on dominant joints. The ore bodies range in size from small tabular masses covering a few square feet to large bodies several hundred feet across. The thickness ranges from 1 foot or less up to about 14 feet. Most of the ore bodies are small elongated masses containing less than 2 or 3 thousand tons. The average grade of the ore shipped ranges from .20 to about .25 percent U_3O_8, and rarely up to .35 percent U_3O_8.

The applicant has developed no ore on this property. There are two showings of uranium mineralization on the rim exposures, and one near the northwest corner of the section that is in a limestone lens near the base of the Summerville formation. The nearest known ore is that discovered in the southern part of sec.23 by the Santa Fe Railroad and in the northern part of sec. 26 by the applicant. Several ore bodies have been found farther southeast in secs. 25, 30, and 31.

In these several sections, the known ore bodies are estimated to contain from 25 to more than 10,000 tons of ore apiece. The average ore body contains on the order of 3,000 tons. The size and distribution of these known deposits might be considered representative of the deposits expected in the area to be explored. The known ore bodies total about 40 in number, and were found by exploration of a combined area about 1.25 square miles in extent. It therefore seems possible that exploration of the applicant's 45 acres (.07 square mile) might discover 2 or 3 deposits that might contain as much as 6,000 to 9,000 tons of ore.

The value of this ore (before initial production bonus and haulage allowance), assuming an average grade between .20 and .25 percent U_3O_8, would range from $16.00 to $20.75 per ton. The value of the anticipated discoveries would therefore expectably be between $96,000 and $186,750.

The known ore bodies range in size from less than 25 feet in diameter up to 100x800 feet. Their small size and irregular shape make them difficult targets for exploration, but where they lie at shallow depths many small ore bodies can and will be mined at a profit. Closely spaced drilling therefore seems justifiable in shallow ground such as the area under consideration.

PROPOSED EXPLORATION

The exploration proposed by the applicant consists of a maximum of 30,410 feet of rotary drilling estimated to cost $26,460.69. It is proposed to do the drilling in three stages: (1) An initial grid of 207 holes (8,919 feet) spaced 100 feet apart to test the whole area; (2) a secondary grid of 286 holes (12,306 feet) consisting of 8 off-set holes spaced 50 feet apart around one initial hole in five; and (3) a tertiary grid of 213 holes (9,186 feet) consisting of 8 off-set holes spaced 25 feet apart around one secondary hole in ten. Radiometric logging would be used to determine which of the initial and secondary holes should be offset. Samples would be collected only from the holes drilled on 25-foot centers, and these samples would be tested radiometrically to determine the grade of the rock cut in drilling. Chemical assays would be made of a few of the samples to check the radiometric determinations.

The field examiners believe the area is favorable for finding uranium deposits, but that the applicant proposed more drilling than is needed for exploration. The following modified program is suggested:

Stage 1: The entire area should be tested with an initial pattern of holes spaced 200 feet apart, beginning 100 feet south of the north boundary line and 100 feet west of the east boundary line. This stage will require 48 holes, averaging 40.5 feet deep for a total of 1944 feet. Although this initial test would find only unusually large deposits, it will test for the presence of the ore-bearing limestone and may by chance find some small deposits. It does not in itself constitute an adequate test of the property because of the small size and narrow elongate shape of the typical deposits.

Stage 2: The second phase of the exploration should, therefore, provide sufficient footage to complete a 100-foot grid pattern, no holes to be drilled within 100 feet of the north and east property lines. Experience has shown that holes drilled on this pattern will indicate the presence of most deposits of average size, and would be accepted as a fair test of the property in the event of completely negative results. This stage will require 123 holes. Assuming they also average 40.5 feet in depth, they would total 4981.5 feet of drilling.

Stage 3: According to P. E. Melancon, AEC geologist, experience in the district indicates that one hole in six drilled on 100-foot centers will cut rock having enough radioactivity to justify off-setting. On this basis 28.5 of the holes drilled in Stages 1 and 2 might require additional holes to test the adjacent ground. Allowing 6 offset holes for each of these 28.5 holes, 171 holes should be provided for in Stage 3. These holes should be spaced 50 feet apart, and may be drilled 50 feet from the property lines. The suggested allowable maximum footage for Stage 3 is 6925.5.

It is further suggested that Stage 1 and Stage 2 holes be completed and their relative favorability be determined before the Stage 3 offset holes are drilled. In this way, the whole area can be appraised and the most favorable parts can be selected for further testing by offset drilling.

This program, totalling 13,851 feet of drilling, presents allowable maximum footages. By beginning with 200-foot spacing in Stage 1, it is possible that some parts of the area can be eliminated from further consideration, thus saving a few holes in stage 2. It is also possible that all of the allowable footage in Stage 3 might not be needed to test whatever favorable indications are obtained in Stages 1 and 2. On the other hand, in the event of many favorable showings, it is desirable to allow the use of unexpended Stage 2 footage in Stage 3. In this way, within the allowable maximum under the contract, some flexibility is obtained even though the program is organized in stages.

No drilling on 25-foot centers, as proposed by the applicant, is suggested, as it is believed that drilling on 100-foot centers with some 50-foot offsets will find most average sized deposits or at least suggest their proximity. Closer spaced drilling, however, probably would be required to obtain a reasonably accurate appraisal of the tonnage and grade of deposits and certainly would be required to develop them for mining. It is believed that the applicant should be willing to do at his own expense the work he considers necessary to develop ore for mining if the greater risks of exploration have already been taken in the DMEA project.

The applicant has proposed to take no samples from the holes drilled on 100- and 50-foot centers, but rather to rely upon radiometric determinations by in-hole logging equipment to select the holes to be offset. Although the AEC field personnel have recommended this practice, and it has been accepted by the DMEA examining team for use on projects already studied, a more critical analysis of the logging method shows that it has not been thoroughly tested and proved. Furthermore, the AEC does not have the capacity to do the radiometric logging on this project whereas they have promised to do it on other DMEA projects, and the applicant proposes instead to use unproved logging equipment. The examining team therefore recommends that, in addition to the proposed radiometric hole logging, samples of the drill cuttings representing 2-foot intervals throughout the Todilto limestone be taken from all drill holes. This sampling will of course increase the cost of the project, but it seems necessary for the present in order to ensure obtaining adequate guidance for the drilling and to establish the reliability of the logging equipment.

Experience in the Grants district has shown that the uranium ore in the limestone is essentially in radioactive equilibrium and that radiometric determinations with laboratory scalers or even with simple portable counters can be used, if the instruments are properly calibrated and checked, to determine the grade of samples. The applicant proposes to use radiometric determinations for assaying samples; 20 chemical assays of samples selected at random are also proposed as checks. The proposed plan of radiometric assaying with 20 chemical assays for checking is considered sound and should be acceptable to DMEA. All drill holes, however, should be sampled as suggested above.

CONCLUSIONS AND RECOMMENDATIONS

Exploration of the Hanosh property in sec. 22, T. 13 N., R. 10 W., McKinley County, N. Mex., by rotary drilling appears to have a favorable chance of finding as much as 6,000 to 9,000 tons of ore containing 0.20 to 0.25 percent U_3O_8. At the present price schedule, this ore will have a value of $96,000 to $186,750, which is probably not sufficient to repay completely the government's share of the cost of exploration. On the basis that the ground offers the chance of finding a significant amount of ore, however, it is recommended that the government enter into a contract for a maximum of 13,851 ~~15,000~~ feet of drilling to cover a primary 200- ~~100-~~foot grid, a secondary 100-foot grid, and about 171 ~~140~~ off-set holes at 50-foot spacing. It is desirable to use in-hole radiometric logging as proposed by the applicant, but cuttings should be collected through the limestone in all holes and selected samples checked by radiometric assay in order to establish the reliability of the technique. A few chemical assays should be provided to check the grade of possible discoveries.

DMEA-3152, HANOSH MINES, INC., URANIUM PROPERTY
McKINLEY COUNTY, NEW MEXICO

Engineering Report

By L. L. Farnham, Mining Engineer
U. S. Bureau of Mines

February 1954

Reviewed by
DMEA OPERATING COMMITTEE
9-3-54
(date)

DMEA-3152, MANOSH MINES, INC., URANIUM PROPERTY
McKINLEY COUNTY, NEW MEXICO

CONTENTS

ILLUSTRATIONS

INTRODUCTION

Late in August 1953, Hanosh Mines, Inc., applied to the Defense Minerals Exploration Administration under the Defense Production Act of 1950, as amended, for an exploration loan amounting to $26,460.69. The application was docketed as DMEA-3152. The funds requested were to be used in search of uranium deposits by means of 30,410 feet of rotary drilling.

The property was visited by the DMEA examiners 1/ on September 15, 1953. The initial engineering report, submitted in October 1953, has been revised in this report in accordance with recent policy decisions.

ACKNOWLEDGMENTS

Acknowledgments are made to Paul E. Melancon, formerly of the Atomic Energy Commission, and to Irving Rapaport for their assistance during the examination.

LOCATION AND PHYSICAL FEATURES

The property is situated about 19 miles north of the town of Grants in the NE$\frac{1}{4}$ of Sec. 22, T. 13 N., R. 10 W., McKinley County, N. Mex. It can be reached by traveling west of Grants on U. S. Highway 66 for 3.2 miles, thence northward on State Highway 53 for 10.8 miles to a side road branching westward. The site of the proposed project is reached by proceeding about 4 miles in a northwesterly direction on this branch road (figure 1). The subject property is 22 miles from the uranium processing plant of the Anaconda Copper Mining Co. near Bluewater.

1/ Streboll, J. D., Geologist, Geological Survey;
Farnham, L. L., Mining Engineer, Bureau of Mines.

The area proposed for exploration is situated on a relatively flat, gently-sloping alluvium-covered bench or mesa. Altitudes above sea level range from a high of 7,120 feet at the southeast corner of the tract to a low of 7,050 feet at the northeast corner.

HISTORY AND PRODUCTION

The first mining activity in the Grants district began in 1950, following the initial discovery of uranium near Haystack Butte (figure 2). These deposits, situated about 4 miles west of the subject property, have proven to be the largest found to date in the district. Large scale production from this area is awaiting the completion of the Anaconda plant near Bluewater. The applicant's property, valuable only for grazing prior to the discovery of uranium in the region, has not been explored. Drilling on contiguous tracts, southeast of that held by the applicant, has disclosed important deposits. Four properties in this area were in production at the time of the examination.

OWNERSHIP AND EXTENT

The applicant reportedly holds a lease on the NE¼ of Sec. 22, T. 13 N., R. 10 W., McKinley County, N. Mex. This property is an Indian allotment and as such is under the jurisdiction of the Bureau of Indian Affairs of the Department of the Interior. A copy of the applicant's lease is not available. It is the writer's understanding that the royalty payments stipulated in the lease are based on a sliding scale starting at 10 percent for ore with a mill value of $20 a ton and increasing one percent for each $10 in added value. Under the lease, royalty is payable on all bonuses, premiums and other allowances received by the shipper.

The area proposed for exploration covers about 43 acres situated in the extreme northeast corner of Sec. 22. The land in Secs. 15 and 23, which immediately adjoins the subject property on the north and east, is either owned or controlled by the Atchison, Topeka & Santa Fe Railway Co. (figure 3). The applicant company is producing ore from another lease covering a portion of Sec. 26, T. 13 N., R. 10 W.

DESCRIPTION OF THE DEPOSITS

Uranium mineralization in the area under consideration occurs in the Todilto limestone. This formation is a persistent gently-dipping bed averaging about 20 feet in thickness. The tract proposed for exploration is underlain by this limestone. Its irregular outcrop marks the western and southern boundaries of the project area (fig. 3). Erosion has completely removed the Todilto limestone from all of Sec. 22 with the exception of the extreme northeastern corner which constitutes the area proposed for exploration. Except in the immediate vicinity of the outcrop the favorable bed is usually completely concealed by varying thicknesses of overburden. This is not only true of the tract under consideration but prevails generally throughout the district. Although showings of uranium mineralization are not uncommon along the outcrop of the Todilto it appears that very few of the district's more important ore bodies have been found exposed in this manner. Closely spaced blind drilling has been the chief means of finding and outlining the present ore reserves of the district.

Exploratory drilling on properties southeast of the subject tract has indicated over 100,000 tons of ore in an irregular belt about 3 miles long that roughly parallels the outcrop of the favorable limestone bed (figure 2). This drilling has been confined to those areas near the outcrop where the limestone was overlain with the least overburden, thus permitting open pit mining. It is reported that drilling has indicated about 30,000 tons of ore on Sec. 23 which adjoins the subject property on the east. None of the details of this work were available. Still farther southeast in Sec. 25, about 300 acres bordering the limestone outcrop was drilled on an initial 100-foot grid. This work found 17 separate ore bodies totaling about 61,000 tons, having an estimated average grade of 0.19 percent U_3O_8. These individual ore bodies were scattered at random and varied greatly in shape, thickness and grade. Some of the smaller ones were of the order of 25 feet long and 25 feet wide. The largest covered an area of about 20,000 square feet. The ore, occupying various horizons in the limestone, ranged from 2 to 14 feet in thickness. In the 300 acres drilled, there were large areas covering 40 or more acres in which no ore bodies were found. In the SW¼ of Sec. 30, T. 13 N., R. 9 W., closely spaced drilling of a 60 acre tract indicated 3 ore bodies totaling about 8,800 tons, having an average grade of approximately 0.25 percent U_3O_8.

Thus in the 360 acres for which the results of former drilling are available, it appears that somewhat less than 200 tons of ore was found per acre. However, within that 360 acres there were tracts of the size of the subject property that contained much more than 200 tons of ore per acre and also there were areas of equivalent size (43 acres) that contained no ore at all.

The principal uranium mineral found in the Todilto limestone is tyuyamunite.

PROPOSED EXPLORATION

The applicant's proposals are quoted as follows:

"It is proposed that an initial 100-foot grid of 207 holes, averaging 43.08 feet in depth, be completed first. The disposition of holes on 50 and 25 foot centers shall be determined by the results obtained by the initial grid. Approximately 20 percent of the holes drilled in the central portion of the Grants District have shown gamma ray counts about three times that of the background count of the hole. Applying this ratio 285.66 offset holes on 50 foot centers are anticipated. Ten percent of the holes on 50 feet centers contained 0.05% U_3O_8 or better. On this basis, 213.25 holes on 25 foot centers are anticipated. Several of the mine owners in this district prefer to continue their search for ore on 10 foot centers. It is our opinion that the large additional expense is not warranted by the small pods of uranium found in this manner."

A summary of the applicant's proposal with costs is given below:

Phase	No. Holes	Avg. Depth	Total Feet	Cost/ft.	Total Cost
Initial grid (100 ft.)	207	43.08*	8,919.00	$0.50	4,459.00
Secondary grid (50 ft.)	285.66	43.08	12,305.43	0.50	6,152.715
Tertiary grid (25 ft.)	213.25	43.08			
(a) Limestone Cuttings required		20.00	4,265.00	1.00	4,265.00
(b) Overburden		23.08	4,921.81	0.50	2,460.905
Totals	706,91	43.08	30,410.24		$17,337.62

Radiometric logging and the preparation of a permanent geologic record of every hole: 30,410.24' @ $0.15 - 4,561.36

Supervision, accounting, correspondence, surveying, collection of cuttings, 30 chemical assays of cuttings, radiometric assays of cuttings, geologic mapping and ore reserve calculations:-

30,410.25' @ $0.15 - 4,561.536

Total maximum cost of exploration program - $26,460.69

*Average hole is composed of:
18.08 feet of overburden (alluvium, siltstone and shale)
20.0 feet of limestone (ore horizon)
5.0 feet of sandstone (underlying Entrada sandstone)

The applicant estimated that 207 holes would be required for the initial 100-foot grid. This estimate evidently was based on holes drilled directly on the northern and eastern property line boundaries.

The Field Team believes, in cases such as this where the adjoining property has different ownership and cannot be subordinated, that the initial holes should not be drilled closer than 200 feet from the adjoining ground. If this is adopted in this instance it will reduce the size of the area to be explored by nearly 14 acres, or from 43 to about 29 acres. As the smaller the tract the less likely it is to contain the average proportion of ore bodies, it is suggested in this case that the initial drilling be started 100 feet from the north and east boundaries of the adjoining property. On this basis the writer recommends the following alternative program:

Stage 1 would consist of drilling the tract with holes spaced 200 feet apart, starting the grid 100 feet south of the north property line and a like distance west of the east side of the tract. This pattern would require 48 holes (figure 3). Holes spaced 200 feet apart would fail to explore an area approaching 40,000 square feet within each 200-foot square. An ore body covering but 10,000 square feet may contain as much as 6,000 tons of ore which is nearly twice the size of the average ore body found by the drilling of 300 acres in sec. 25 (figure 2). Consequently negative results at the end of stage 1 would not necessarily warrant the termination of this project.

Stage 2: Because of the favorable mining conditions prevailing on this property and the relatively small size of the targets, it appears advisable to allow sufficient additional footage under stage 2 so that each initial hole of Stage 1 may be offset on a 100-feet grid pattern (figure 3). Stage 2 would then require an additional 123 holes, none to be drilled closer than 100 feet from the boundary lines of the property.

Stage 3: After the completion of stages 1 and 2, the entire tract will have been drilled on a 100-foot grid pattern. According to Paul Melancon, former Chief of the Atomic Energy Commission's office in Grants, prior drilling experience in the district has indicated that about one sixth of the holes drilled on a 100-foot grid pattern can be expected to warrant offsetting. On this basis, if all the 171 holes of stages 1 and 2 were drilled, about 28.5 of this number could be expected to warrant offset holes, spaced 50 feet apart. Assuming that each of these 28.5 holes will require an average of 6 offsets, then stage 3 would consist of 171 holes drilled on a 50-foot offset pattern in the favorable areas indicated by former holes. This estimated amount of drilling constitutes the allowable maximum. For instance, if only 10 of the holes drilled in stages 1 and 2 were considered worthy of offsetting, then stage 3 would consist of but 60 holes. In case stages 1 and 2 found no holes that would justify offsets, then of course, the project would be terminated. None of stage 3 holes should be drilled closer than 50 feet from the property lines. Any unexpended footage in stage 2 should be transferred to stage 3 upon approval of the Field Team.

Once started, rotary drilling will proceed very rapidly, perhaps as many as 6 holes being completed daily. Just what constitutes a hole worthy of offsetting may in some cases be a difficult problem. Complications with the drilling contractor will arise if his equipment is idle while awaiting decisions. The highly important sampling procedure may be faulty and questions may arise as to the true depth of some of the holes that have partially caved. To obviate some of the foreseeable difficulties it might be advisable to have a DMEA representative on the job during a large part of the time that the project is under way. Such an arrangement would seem more advisable if 2 DMEA projects were operating in the district at the same time.

The alternative program recommended by the writer is summarized as follows:

Stage 1 - 48 holes on a 200-foot grid;

Stage 2 - 123 holes on a 100-foot offset pattern;

Stage 3 - 171 holes on a 50-foot offset pattern.

Total 342 holes

From figure 3, the distance between the surface and the base of the Todilto limestone was found to average about 37.5 feet. Allowing an additional 3 feet of drilling below the bottom of the limestone to permit probing, the average depth of the holes would be about 40.5 feet. Thus 342 holes would require 13,851 feet of drilling. This amount of exploration would appear adequate for the purpose of disclosing whether or not the property contained worthwhile ore bodies.

If the host limestone underlying the area proposed for exploration averages 20 feet in thickness, then the average depth of overburden would be about 18 feet. For ore found below that amount of overburden, stripping and open-pit mining would be feasible. Under these favorable conditions the mining cost including stripping, as judged from similar operations, would probably not cost more than $8 a ton. If ore averaging 0.20 percent U_3O_8 was found on the property, it would have the following value per ton, f.o.b. mine:

Base price (4 lbs. @ \$3.50)	\$14.00
Premium (excess over 4 lbs. @ \$0.75)	None
Development allowance (4 lbs @ \$0.50)	2.00
Hauling allowance (22 miles @ \$0.06)	1.32
Total value	\$17.32

A bonus amounting to an additional \$14.00 a ton would apply on the initial 10,000 pounds of U_3O_8, or in this case on the first 2,500 tons of 0.20 percent ore produced. Thus the average value of the initial 2,500 tons would be \$31.32. If a total of 9,000 tons of 0.20 percent ore was found on the property it would have an average value of \$21.20. On ore of this value the royalties, consisting of 11 percent to the lessor and 5 percent to the Government, would amount to \$3.39 a ton. With operating costs of \$8, the resulting profit would be nearly \$10 a ton. Hence small ore bodies, under thin overburden, though they contained but a few hundred tons would be profitable and no doubt mined, thus constituting a source of uranium.

It is recognized that an ore body containing but a few hundred tons cannot be considered significant, yet the combined output of all the numerous smaller deposits in the district would be substantial. However, the search for these small average grade deposits by closely spaced drilling is justified only in areas of such shallow overburden as to permit open-pit mining. An experienced operator in the district expressed the opinion that a deposit of average size and grade becomes marginal when covered by more than 35 feet of overburden.

SAMPLING

All the holes drilled under the project should be logged radiometrically and samples collected from the ore-bearing bed as well. An accurate log and the sample results of each hole should be made and recorded by the applicant. In this case the limestone would be sampled in 342 holes by catching the cuttings at each 2-foot interval. If the limestone averaged 20 feet in thickness, 10 samples would be taken from each hole. These samples should be split over a Jones riffle and a representative portion sacked, labeled, and preserved for future checking. The other portion of the sample could be scanned with a calibrated Geiger Counter and those that appeared to be of near ore-grade or better should be assayed.

The applicant proposed assaying all of these samples radiometrically with 20 of the number checked by chemical analyses. It has been shown that the results obtained by radiometric assaying of the limestone ores in the district check very closely with the results obtained by chemical methods. Consequently in this case radiometric assaying of the samples with 20 chemical checks should be satisfactory for the purpose of the proposed exploration.

ESTIMATED COSTS OF THE PROJECT

The applicant proposed that the Four Corners Exploration Co. of Grants be given an independent contract covering all phases of the contemplated exploration. The costs of this complete service as submitted by the above contractor are summarized as follows:

Drilling:

1st 100 feet or any part thereof - $0.50 a foot
2nd 100 feet or any part thereof - 1.00 a foot
Blowing hole clean and catching cuttings every 2 feet - $0.50 a foot extra over regular prices.

Radiometric logging and preparation of a permanent geologic record of every hole: - $0.15 a foot. Supervision, accounting, correspondence, surveying, collection of samples, 20 chemical assays of cuttings, radiometric assay cuttings, geologic mapping and ore reserve calculations: - $0.15 a foot.

These prices appear reasonable and so far as the drilling is concerned, they are competitive with other contracts in the district.

The average depth of the proposed holes was calculated from the Atomic Energy Commission's topographic map of the area, and structural contours which were based on the presumption that the average dip of the limestone was about 10 feet vertically in 140 feet horizontally (figure 3). From these data the depth of the proposed holes was found to average 37.5 feet. An additional 3 feet of drilling below the base of limestone is desirable in order to afford space for any caving that might occur before the hole could be probed with the radiometric logging device. The applicant desired an extra 5 feet of drilling for this purpose but in the case of such relatively shallow holes it would seem that 3 feet would be sufficient. Thus by allowing 3 feet of extra drilling below the base of the limestone the average depth of the holes would be about 40.5 feet.

Based on the foregoing bid of the Four Corners Exploration Co. the estimated cost of the alternative program would be as follows:

Stage	Grid Pattern	Number of Holes	Depth, Feet	Total Feet	Price per Foot	Cost
1	200 feet	48	40.5	1,944	$0.50	$972.00
2	100 feet	123	40.5	4,981.5	0.50	2,490.75
3	50 feet	171	40.5	6,925.5	0.50	3,462.75
	Totals	342		$13,851.0		$6,925.50

Sampling: 342 holes over 20 ft. thickness = 6,840 ft. @ $0.50	3,420.00
Radiometric logging - 13,851. ft. @ $0.15	2,077.65
All other costs - 13,851 ft. @ $0.15	2,077.65
Total	$14,500.80
Average cost per foot	$1.05

Working continuously 26 days a month with an average footage of 250 feet per day the drilling could be completed in slightly over 2 months.

PROPOSED FINANCING

The project as estimated by the writer would cost $14,500 of which the applicant would furnish 10 percent, or $1,450 and the Government would provide $13,050.

The ore produced from neighboring properties has averaged about $22 a ton. With ore of this value and a 5 percent royalty the subject property would have to produce about 11,860 tons of ore in order to repay the Government loan. Judged by the information available, the tonnage indicated by the drilling on neighboring properties has averaged about 200 tons of ore per acre. On that basis the 43 acres in question could be expected to yield 8,600 tons of ore. However, because of the unpredictable erratic distribution of the deposits, the subject property could contain more than 8,600 tons, and likewise could contain much less.

CONCLUSIONS AND RECOMMENDATIONS

The productive limestone throughout the area is for the most part completely covered with alluvium or younger sediments so that the only means available for judging the merits of an unexplored tract is its location to known trends and/or its proximity to known ore bodies. The subject property lies within the projected trend of an irregular belt of the Todilto limestone in which ore has been found on neighboring properties and for that reason it is considered worthy of exploration.

The ore-bearing bed underlying the area proposed for exploration is covered with such a thin matte of overburden that any ore found could be mined cheaply in open pits. This would permit the production of uranium from smaller and lower-grade ore bodies than would be economically feasible where a large amount of stripping or underground mining was necessary. Consequently in areas of shallow overburden, such as the tract in question, there is justification for closely spaced drilling in order to discover as many as possible of the smaller, yet profitable ore bodies.

The applicant proposed to award the drilling contract to the Four Corners Exploration Co. This company is a newly formed organization owned jointly by F. O. Hanel and Irving Rapaport, both of Grants, N. Mex.

Rappart is a graduate geologist with about 4 years experience in uranium exploration. He was employed about 3 years of that time by the Atomic Energy Commission as project supervisor in Utah and New Mexico. For the past year he has been managing the exploration and mining operations of the Hanosh Mines, Inc. F. O. Manel, the other partner, has been exploiting a uranium property in the Grants district for the past year and a half with considerable success. The equipment belonging to the Four Corners Exploration consisted of a Failing 1500 mobile rotary drilling rig with auxilliary air compressor and Duclone sampler. A truck mounted radiometric hole logging unit had been ordered and delivery was expected late in October 1953. Whether or not it is available at this time is not known.

As there appears to be a reasonable chance of finding ore on the subject property it is recommended that a loan amounting to $14,500 be approved. A short form contract is suggested specifying a maximum of 13,850 feet of drilling at a price of$1.05 a foot.

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

August 27, 1954.

Memorandum

To: Secretary to the Operating Committee, DMEA

From: Executive Officer, DMEA Field Team, Region IV

Subject: Docket No. DMEA-3152 (Uranium), Hanosh Mines, Inc., McKinley County, New Mexico.

Enclosed are four copies of the report of field examination on the subject application and two copies of Form 3b.

This docket has been closed by this office effective August 16, 1954 because the applicant has not provided an approved Assignment of Lease.

W H King
W. H. King

Enclosures

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Mining Division
Region IV

March 3, 1954.

Memorandum

To: Field Team, Region IV

From: Chief, Mining Division, Region IV

Subject: Report of Examination - DMEA Docket 3152 (Uranium), Hanosh Mines, Inc., McKinley County, New Mexico.

Enclosed are eleven copies of the engineering report of examination on the subject docket.

The applicant requested $26,460.69 to drill the property on a scale which appears to be too ambitious to the examining engineer.

The examining engineer recommends a drilling program to be divided into three stages, the work to consist of 342 holes averaging 40.5 feet in depth at an estimated total cost of $13,851.00.

We concur in this recommendation.

W H King
W. H. King

Enclosures

February 19, 1954

Memorandum

To : W. H. King, Chief, Mining Division, Region IV

From : Chief, Mining Methods Br., Mining Div., Region IV

Subject : Engineering Report on Docket DMEA-3152, Hanosh Mines, Inc., Uranium Property, McKinley County, N. Mex.

Enclosed are original and 9 copies of a revised report by Lloyd L. Farnham of the Bureau of Mines on the above property. The other copy will be forwarded to you by R. P. Fischer of the Geological Survey's Grand Junction office. J. D. Strobell of the Geological Survey has read and approved this report by Farnham.

The DMEA field examiners recommend that Hanosh Mines, Inc. be granted exploration assistance to drill its property north of Grants, N. Mex. I concur with this recommendation.

Walter R. Storms

Walter R. Storms

cc W. H. King (10)
R. P. Fischer
DMEA-3152
DF

WRStorms:frj

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Defense Minerals Exploration Administration
Denver Federal Center
Denver 2, Colorado

February 23, 1954

Memorandum

To: DMEA Field Team, Region IV

From: A. H. Koschmann

Subject: DMEA Docket 3152, Henosh Mines, Inc., McKinley County, New Mexico

Enclosed are 11 copies of a geologic report by J. D. Strobell, Jr., of the U. S. Geological Survey covering the above docket.

The recommended plan of exploration has been revised to agree with that suggested by Lloyd Farnham of the Bureau of Mines office in Tucson, as requested by the Field Team in December.

A. H. Koschmann

A. H. Koschmann
Supervising Geologist
Colorado-Wyoming

Enclosures (11)

C
O
P
Y

UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey
P. O. Box 360
Grand Junction, Colo.

February 24, 1954.

Memorandum

To: W. H. King, DMEA Field Team, Region IV

From: R. P. Fischer, Colorado Plateau District

Subject: DMEA 3152, Hanosh Mines, Inc., Uranium Property, McKinley County, New Mexico.

Forwarded herewith is carbon copy of Farnham's report, DMEA 3152, Hanosh Mines, Inc., Uranium Property, McKinley County, New Mexico, as requested by Storms in his memorandum of February 17.

/s/ R. P. Fischer
District Supervisor

Enclosure

C
O
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Y

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
P. O. Box 360
Grand Junction, Colo.

February 19, 1954.

MEMORANDUM

TO: A. H. Koschmann, Field Team, Region IV

From: R. P. Fischer, Supervisor,
Colorado Plateau District

Subject: DMEA 3152, Hanosh Mines, Inc., McKinley County, New Mexico

Transmitted herewith are 11 copies of Strobell's revised report on the above application. The recommended plan of exploration has been revised to agree with that suggested by Lloyd Farnham of the Bureau of Mines office in Tucson, as requested by the Field Team in December.

Enclosures 11

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
P. O. BOX 360
GRAND JUNCTION, COLORADO

October 9, 1953

Memorandum

To: A. H. Koschmann, DMEA Field Team, Region IV

From: R. P. Fischer, Acting Supervisor
Colorado Plateau District

Subject: DMEA 3152, Hanosh Mines, Inc., McKinley County, New Mexico

Transmitted herewith are eleven copies of a geologic report on the ground leased by the Hanosh Mines, Inc., McKinley County, N. Mex. The company applied for assistance in exploring for uranium; they propose to do 30,410 feet of drilling and related work at an estimated cost of $26,460.69.

The attached report is prepared by J. D. Strobell, Jr., and is based on a joint field examination on September 15 with Lloyd Farnham, USBM, and Irving Rapaport, representing the applicants. The examining team also conferred with P. E. Melancon, AEC geologist, who is in general agreement with the conclusions and recommendations offered in the report.

Strobell concludes that exploration in the area has a good chance of finding 6,000 to 9,000 tons of ore, and thus is favorable for exploration. On this basis, he recommends an exploration contract, pointing out at the same time, however, that the value of the ore expected probably will not be sufficient to repay through royalty payments the entire cost to the government. A program of ~~15,000~~ 13,851 feet of drilling, smaller than that proposed by the applicant, is suggested.

I concur with these conclusions and the suggested plan of exploration.

R. P. Fischer

R. P. Fischer
Acting District Supervisor

Enclosures 11

RPF/mlr

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

In August 1953, Hanosh Mines, Inc. applied to the Defense Minerals Exploration Administration, under the Defense Production Act of 1950, as amended, for an exploration loan amounting to $26,460.69. The application was docketed as DMEA-3152. The funds requested were to be used in the exploratory drilling of a uranium prospect situated in the Grants district of northwestern New Mexico. The property was examined 1/ on September 15, 1953.

Extensive exploration has been under way in the Grants region since 1950 when the presence of uranium first was detected. The deposits occur as sporadic, irregular, blanket-type replacements in the Todilto limestone and also in some of the overlying formations. The Todilto in the Grants area is a persistent gently dipping (4°) bed about 20 feet in thickness which owing to its relative resistance to erosion, usually caps many of the lower benches and mesas along the valley floors.

The project property covers an unexplored area of about 43 acres that is underlain by this ore-bearing limestone. Except in the immediate vicinity of the outcrop the favorable bed is usually completely covered with varying amounts of soil and younger sediments, which increase progressively in thickness down the dip of the limestone. This mantle of overburden not only covers the area proposed for exploration but prevails generally throughout the district. Structural controls or other ore-guides usually are lacking so that closely spaced

1/ Farnham, L. L., Mining Engineer, Bureau of Mines;
Strobell, J. D., Geologist, Geological Survey

blind drilling has been, and still is the only practical means of discovering ore in the district. Exploratory drilling of this nature has found important, but sporadic ore bodies occupying an irregular belt that extends for about 3 miles to the southeast and for some 4 miles west of the subject property.

The applicant proposed to explore the 43-acre tract by 30,410 feet of rotary drilling in 706 holes, spaced from 100 to 25 feet apart. This work was estimated to cost $26,460.69. As this amount of drilling appeared excessive for the purpose of exploration, an alternative program was recommended which involved 13,850 feet of drilling in 342 holes at an estimated cost of $14,500.

The area proposed for exploration is favorably situated in respect to a productive trend and for that reason it appears to be worthy of exploration. Therefore, it is recommended that a loan amounting to not more than $14,500 be approved.

UNITED STATES DEPARTMENT OF THE INTERIOR
DOUGLAS McKAY, SECRETARY

DEFENSE MINERALS EXPLORATION ADMINISTRATION

REPORT OF EXAMINATION BY FIELD TEAM
REGION IV

DMEA 3152, Hanosh Mines, Inc., Section 22, T. 13 N., R. 10 W., Grants District, McKinley County, New Mexico

Uranium

Geologic report

J. D. Strobell, Jr., Geologist
U. S. Geological Survey

October 9, 1953

HANOSH MINES, INC.,
McKINLEY COUNTY, NEW MEXICO

INTRODUCTION AND SUMMARY

Application has been made by Hanosh Mines, Inc., for government assistance (DMEA 3152) in exploring for uranium in the Todilto limestone of the Grants District, McKinley County, N. Mex. The applicant proposes 30,410 feet of drilling, at an estimated cost of $26,460.69, to explore about 45 acres in the NE 1/4, sec. 22, T. 13 N., R. 10 W. The property was examined on September 15, by Lloyd Farnham of the U. S. Bureau of Mines, Tucson, Ariz., and J. D. Strobell, Jr., of the U. S. Geological Survey, Grand Junction, Colo. The examiners were accompanied by the applicant's representative, Mr. Irving Rapaport, and conferred also with Mr. P. E. Melancon, District Geologist of the U. S. Atomic Energy Commission, Grants, N. Mex.

The property lies on allotted Indian lands. Prospecting and mining rights are leased to the applicant with the approval and under the general supervision of the Bureau of Indian Affairs, U. S. Department of the Interior. Royalties stipulated by that Bureau range from 10 to 20 percent of the mine value of the ore (excluding allowances for development and transportation) and include in addition 10 percent of any bonuses paid by the U. S. Atomic Energy Commission.

A somewhat curtailed program (about 50 percent reduction) to explore this property with government assistance is recommended. The applicant's proposal is considered to carry the exploration too far into the development phase not appropriately a part of DMEA exploration. A maximum of ~~15,000~~ 13,851 feet of drilling in primary and offset holes is recommended. It is also suggested that in addition to the radiometric logging of these holes proposed by the applicant, collection of cuttings from the limestone be required until such time as the reliability of radiometric logging is definitely established in the district.

GEOLOGY

In the Grants district, uranium deposits occur in the Todilto limestone and Morrison sandstone beds of Jurassic age, and in the overlying Cretaceous rocks. The Hanosh lease in sec. 22 covers an area underlain by the Todilto limestone. The Todilto caps cliffs of the underlying Entrada sandstone and forms a broad bench where the overlying Summerville formation has been removed by erosion. It dips very gently northeastward across the property and is covered by a veneer of dune sand and alluvium up to about 50 feet thick, which may also locally conceal remnants of the Summerville formation. Except along the rim at the top of the Entrada cliff, the limestone is completely covered on the Hanosh property. Near the northern edge of the property increasing amounts of the silty sandstone of the Summerville formation are likely to be present. The limestone is about 20 feet thick on the average, and the applicant states that the overburden on the property averages only 18 feet in thickness.

ORE DEPOSITS

In the Grants district, uraniferous minerals locally coat bedding planes and joint surfaces of the limestone, are disseminated in blebs and crystals, and are associated with coarsely crystalline carbonates in veinlets. Among the important ore minerals are tyuyamunite, carnotite, uranophane, and uraninite. These minerals are locally present in sufficient amounts to form ore bodies of irregular plan and thickness without sharply defined limits. Controls of their localization are not well understood. The ore bodies occur at all positions between the top and bottom of the limestone. There is evidence of their localization along the axial portion of minor folds, but not all such folds are mineralized. This produces elongated ore bodies, as does localization on dominant joints. The ore bodies range in size from small tabular masses covering a few square feet to large bodies several hundred feet across. The thickness ranges from 1 foot or less up to about 14 feet. Most of the ore bodies are small elongated masses containing less than 2 or 3 thousand tons. The average grade of the ore shipped ranges from .20 to about .25 percent U_3O_8, and rarely up to .35 percent U_3O_8.

The applicant has developed no ore on this property. There are two showings of uranium mineralization on the rim exposures, and one near the northwest corner of the section that is in a limestone lens near the base of the Summerville formation. The nearest known ore is that discovered in the southern part of sec.23 by the Santa Fe Railroad and in the northern part of sec. 26 by the applicant. Several ore bodies have been found farther southeast in secs. 25, 30, and 31.

In these several sections, the known ore bodies are estimated to contain from 25 to more than 10,000 tons of ore apiece. The average ore body contains on the order of 3,000 tons. The size and distribution of these known deposits might be considered representative of the deposits expected in the area to be explored. The known ore bodies total about 40 in number, and were found by exploration of a combined area about 1.25 square miles in extent. It therefore seems possible that exploration of the applicant's 45 acres (.07 square mile) might discover 2 or 3 deposits that might contain as much as 6,000 to 9,000 tons of ore.

The value of this ore (before initial production bonus and haulage allowance), assuming an average grade between .20 and .25 percent U_3O_8, would range from $16.00 to $20.75 per ton. The value of the anticipated discoveries would therefore expectably be between $96,000 and $186,750.

The known ore bodies range in size from less than 25 feet in diameter up to 100x800 feet. Their small size and irregular shape make them difficult targets for exploration, but where they lie at shallow depths many small ore bodies can and will be mined at a profit. Closely spaced drilling therefore seems justifiable in shallow ground such as the area under consideration.

PROPOSED EXPLORATION

The exploration proposed by the applicant consists of a maximum of 30,410 feet of rotary drilling estimated to cost $26,460.69. It is proposed to do the drilling in three stages: (1) An initial grid of 207 holes (8,919 feet) spaced 100 feet apart to test the whole area; (2) a secondary grid of 286 holes (12,306 feet) consisting of 8 off-set holes spaced 50 feet apart around one initial hole in five; and (3) a tertiary grid of 213 holes (9,186 feet) consisting of 8 off-set holes spaced 25 feet apart around one secondary hole in ten. Radiometric logging would be used to determine which of the initial and secondary holes should be offset. Samples would be collected only from the holes drilled on 25-foot centers, and these samples would be tested radiometrically to determine the grade of the rock cut in drilling. Chemical assays would be made of a few of the samples to check the radiometric determinations.

The field examiners believe the area is favorable for finding uranium deposits, but that the applicant proposed more drilling than is needed for exploration. The following modified program is suggested:

Stage 1: The entire area should be tested with an initial pattern of holes spaced 200 feet apart, beginning 100 feet south of the north boundary line and 100 feet west of the east boundary line. This stage will require 48 holes, averaging 40.5 feet deep for a total of 1944 feet. Although this initial test would find only unusually large deposits, it will test for the presence of the ore-bearing limestone and may by chance find some small deposits. It does not in itself constitute an adequate test of the property because of the small size and narrow elongate shape of the typical deposits.

Stage 2: The second phase of the exploration should, therefore, provide sufficient footage to complete a 100-foot grid pattern, no holes to be drilled within 100 feet of the north and east property lines. Experience has shown that holes drilled on this pattern will indicate the presence of most deposits of average size, and would be accepted as a fair test of the property in the event of completely negative results. This stage will require 123 holes. Assuming they also average 40.5 feet in depth, they would total 4981.5 feet of drilling.

Stage 3: According to P. E. Melancon, AEC geologist, experience in the district indicates that one hole in six drilled on 100-foot centers will cut rock having enough radioactivity to justify off-setting. On this basis 28.5 of the holes drilled in Stages 1 and 2 might require additional holes to test the adjacent ground. Allowing 6 offset holes for each of these 28.5 holes, 171 holes should be provided for in Stage 3. These holes should be spaced 50 feet apart, and may be drilled 50 feet from the property lines. The suggested allowable maximum footage for Stage 3 is 6925.5.

It is further suggested that Stage 1 and Stage 2 holes be completed and their relative favorability be determined before the Stage 3 offset holes are drilled. In this way, the whole area can be appraised and the most favorable parts can be selected for further testing by offset drilling.

This program, totalling 13,851 feet of drilling, presents allowable maximum footages. By beginning with 200-foot spacing in Stage 1, it is possible that some parts of the area can be eliminated from further consideration, thus saving a few holes in stage 2. It is also possible that all of the allowable footage in Stage 3 might not be needed to test whatever favorable indications are obtained in Stages 1 and 2. On the other hand, in the event of many favorable showings, it is desirable to allow the use of unexpended Stage 2 footage in Stage 3. In this way, within the allowable maximum under the contract, some flexibility is obtained even though the program is organized in stages.

No drilling on 25-foot centers, as proposed by the applicant, is suggested, as it is believed that drilling on 100-foot centers with some 50-foot offsets will find most average sized deposits or at least suggest their proximity. Closer spaced drilling, however, probably would be required to obtain a reasonably accurate appraisal of the tonnage and grade of deposits and certainly would be required to develop them for mining. It is believed that the applicant should be willing to do at his own expense the work he considers necessary to develop ore for mining if the greater risks of exploration have already been taken in the DMEA project.

The applicant has proposed to take no samples from the holes drilled on 100- and 50-foot centers, but rather to rely upon radiometric determinations by in-hole logging equipment to select the holes to be offset. Although the AEC field personnel have recommended this practice, and it has been accepted by the DMEA examining team for use on projects already studied, a more critical analysis of the logging method shows that it has not been thoroughly tested and proved. Furthermore, the AEC does not have the capacity to do the radiometric logging on this project whereas they have promised to do it on other DMEA projects, and the applicant proposes instead to use unproved logging equipment. The examining team therefore recommends that, in addition to the proposed radiometric hole logging, samples of the drill cuttings representing 2-foot intervals throughout the Todilto limestone be taken from all drill holes. This sampling will of course increase the cost of the project, but it seems necessary for the present in order to ensure obtaining adequate guidance for the drilling and to establish the reliability of the logging equipment.

Experience in the Grants district has shown that the uranium ore in the limestone is essentially in radioactive equilibrium and that radiometric determinations with laboratory scalers or even with simple portable counters can be used, if the instruments are properly calibrated and checked, to determine the grade of samples. The applicant proposes to use radiometric determinations for assaying samples; 20 chemical assays of samples selected at random are also proposed as checks. The proposed plan of radiometric assaying with 20 chemical assays for checking is considered sound and should be acceptable to DMEA. All drill holes, however, should be sampled as suggested above.

CONCLUSIONS AND RECOMMENDATIONS

Exploration of the Hanosh property in sec. 22, T. 13 N., R. 10 W., McKinley County, N. Mex., by rotary drilling appears to have a favorable chance of finding as much as 6,000 to 9,000 tons of ore containing 0.20 to 0.25 percent U_3O_8. At the present price schedule, this ore will have a value of $96,000 to $186,750, which is probably not sufficient to repay completely the government's share of the cost of exploration. On the basis that the ground offers the chance of finding a significant amount of ore, however, it is recommended that the government enter into a contract for a maximum of ~~15,000~~ 13,851 feet of drilling to cover a primary ~~100-~~ 200-foot grid, a secondary 100-foot grid, and about ~~140~~ 171 off-set holes at 50-foot spacing. It is desirable to use in-hole radiometric logging as proposed by the applicant, but cuttings should be collected through the limestone in all holes and selected samples checked by radiometric assay in order to establish the reliability of the technique. A few chemical assays should be provided to check the grade of possible discoveries.

DMEA-3152, HANOSH MINES, INC., URANIUM PROPERTY
McKINLEY COUNTY, NEW MEXICO

Engineering Report

By L. L. Farnham, Mining Engineer
U. S. Bureau of Mines

February 1954

DMEA-3152, HANOSH MINES, INC., URANIUM PROPERTY
McKINLEY COUNTY, NEW MEXICO

CONTENTS

ILLUSTRATIONS

INTRODUCTION

Late in August 1953, Hanosh Mines, Inc., applied to the Defense Minerals Exploration Administration under the Defense Production Act of 1950, as amended, for an exploration loan amounting to $26,460.69. The application was docketed as DMEA-3152. The funds requested were to be used in search of uranium deposits by means of 30,410 feet of rotary drilling.

The property was visited by the DMEA examiners 1/ on September 15, 1953. The initial engineering report, submitted in October 1953, has been revised in this report in accordance with recent policy decisions.

ACKNOWLEDGMENTS

Acknowledgments are made to Paul E. Melancon, formerly of the Atomic Energy Commission, and to Irving Rapaport for their assistance during the examination.

LOCATION AND PHYSICAL FEATURES

The property is situated about 19 miles north of the town of Grants in the NE$\frac{1}{4}$ of Sec. 22, T. 13 N., R. 10 W., McKinley County, N. Mex. It can be reached by traveling west of Grants on U. S. Highway 66 for 3.2 miles, thence northward on State Highway 53 for 10.8 miles to a side road branching westward. The site of the proposed project is reached by proceeding about 4 miles in a northwesterly direction on this branch road (figure 1). The subject property is 22 miles from the uranium processing plant of the Anaconda Copper Mining Co. near Bluewater.

1/ Strobell, J. D., Geologist, Geological Survey;
Farnham, L. L., Mining Engineer, Bureau of Mines.

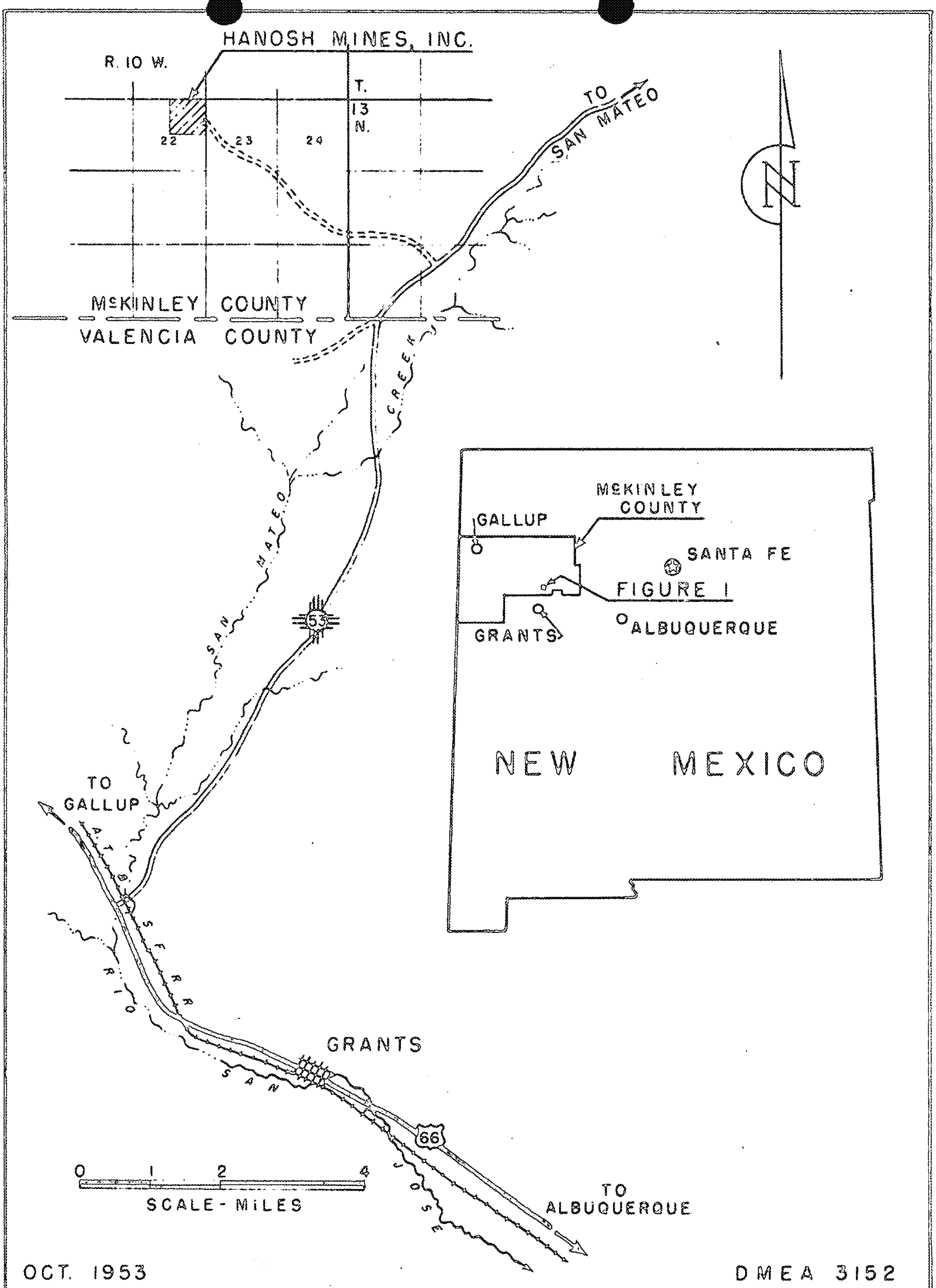

FIGURE 1, - LOCATION MAP - HANOSH MINES, INC.
McKINLEY COUNTY, NEW MEXICO

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The area proposed for exploration is situated on a relatively flat, gently-sloping alluvium-covered bench or mesa. Altitudes above sea level range from a high of 7,120 feet at the southeast corner of the tract to a low of 7,050 feet at the northeast corner.

HISTORY AND PRODUCTION

The first mining activity in the Grants district began in 1950, following the initial discovery of uranium near Haystack Butte (figure 2). These depositx, situated about 4 miles west of the subject property, have proven to be the largest found to date in the district. Large scale production from this area is awaiting the completion of the Anaconda plant near Bluewater. The applicant's property, valuable only for grazing prior to the discovery of uranium in the region, has not been explored. Drilling on continguous tracts, southeast of that held by the applicant, has disclosed important deposits. Four properties in this area were in production at the time of the examination.

OWNERSHIP AND EXTENT

The applicant, reportedly holds a lease on the NE$\frac{1}{4}$ of Sec. 22, T. 13 N., R. 10 W., McKinley County, N. Mex. This property is an Indian allotment and as such is under the jurisdiction of the Bureau of Indian Affairs of the Department of the Interior. A copy of the applicant's lease is not available. It is the writer's understanding that the royalty payments stipulated in the lease are based on a sliding scale starting at 10 percent for ore with a mill value of $20 a ton and increasing one percent for each $10 in added value. Under the lease, royalty is payable on all bonuses, premiums and other allowances received by the shipper.

Exploratory drilling on properties southeast of the subject tract has indicated over 100,000 tons of ore in an irregular belt about 3 miles long that roughly parallels the outcrop of the favorable limestone bed (figure 2). This drilling has been confined to those areas near the outcrop where the limestone was overlain with the least overburden, thus permitting open pit mining. It is reported that drilling has indicated about 30,000 tons of ore on Sec. 23 which adjoins the subject property on the east. None of the details of this work were available. Still farther southeast in Sec. 25, about 300 acres bordering the limestone outcrop, was drilled on an initial 100-foot grid. This work found 17 separate ore bodies totaling about 61,000 tons, having an estimated average grade of 0.19 percent U_3O_8. These individual ore bodies were scattered at random and varied greatly in shape, thickness and grade. Some of the smaller ones were of the order of 25 feet long and 25 feet wide. The largest covered an area of about 20,000 square feet. The ore, occupying various horizons in the limestone, ranged from 2 to 14 feet in thickness. In the 300 acres drilled, there were large areas covering 40 or more acres in which no ore bodies were found. In the SW$\frac{1}{4}$ of Sec. 30, T. 13 N., R. 9 W., closely spaced drilling of a 60 acre tract indicated 3 ore bodies totaling about 9,000 tons, having an average grade of approximately 0.25 percent U_3O_8.

Thus in the 360 acres for which the results of former drilling are available, it appears that somewhat less than 200 tons of ore was found per acre. However, within that 360 acres there were tracts of the size of the subject property that contained much more than 200 tons of ore per acre and also there were areas of equivalent size (43 acres) that contained no ore at all.

The principal uranium mineral found in the Todilto limestone is tyuyamunite.

PROPOSED EXPLORATION

The applicant's proposals are quoted as follows:

"It is proposed that an initial 100-foot grid of 207 holes, averaging 43.08 feet in depth, be completed first. The disposition of holes on 50 and 25 foot centers shall be determined by the results obtained by the initial grid. Approximately 20 percent of the holes drilled in the central portion of the Grants District have shown gamma ray counts about three times that of the background count of the hole. Applying this ratio 285.66 offset holes on 50 foot centers are anticipated. Ten percent of the holes on 50 foot centers contained 0.05% U_3O_8 or better. On this basis, 213.25 holes on 25 foot centers are anticipated. Several of the mine owners in this district prefer to continue their search for ore on 10 foot centers. It is our opinion that the large additional expense is not warranted by the small pods of uranium found in this manner."

A summary of the applicant's proposal with costs is given below:

Phase	No. Holes	Avg. Depth	Total Feet	Cost/ft.	Total Cost
Initial grid (100 ft.)	207	43.08*	8,919.00	$0.50	4,459.00
Secondary grid (50 ft.)	285.66	43.08	12,305.43	0.50	6,152.715
Tertiary grid (25 ft.)	213.25	43.08			
(a) Limestone Cuttings required		20.00	4,265.00	1.00	4,265.00
(b) Overburden		23.08	4,921.81	0.50	2,460.905
Totals	705,91	43.08	30,410.24		$17,337.62

Radiometric logging and the preparation of a permanent geologic record of every hole: 30,410.24' @ $0.15 -	4,561.36
Supervision, accounting, correspondence, surveying, collection of cuttings, 20 chemical assays of cuttings, radiometric assays of cuttings, geologic mapping and ore reserve calculations:- 30,410.25' @ $0.15 -	4,561.536
Total maximum cost of exploration program -	$26,460.69

*Average hole is composed of:
18.08 feet of overburden (alluvium, siltstone and shale)
20.0 feet of limestone (ore horizon)
5.0 feet of sandstone (underlying Entrada sandstone)

The applicant estimated that 207 holes would be required for the initial 100-foot grid. This estimate evidently was based on holes drilled directly on the northern and eastern property line boundaries.

The Field Team believes, in cases such as this where the adjoining property has different ownership and cannot be subordinated, that the initial holes should not be drilled closer than 200 feet from the adjoining ground. If this is adopted in this instance it will reduce the size of the area to be explored by nearly 14 acres, or from 43 to about 29 acres. As the smaller the tract the less likely it is to contain the average proportion of ore bodies, it is suggested in this case that the initial drilling be started 100 feet from the north and east boundaries of the adjoining property. On this basis the writer recommends the following alternative program:

Stage 1 would consist of drilling the tract with holes spaced 200 feet apart, starting the grid 100 feet south of the north property line and a like distance west of the east side of the tract. This pattern would require 48 holes (figure 3). Holes spaced 200 feet apart would fail to explore an area approaching 40,000 square feet within each 200-foot square. An ore body covering but 10,000 square feet may contain as much as 6,000 tons of ore which is nearly twice the size of the average ore body found by the drilling of 300 acres in sec. 25 (figure 2). Consequently negative results at the end of stage 1 would not necessarily warrant the termination of this project.

Stage 2: Because of the favorable mining conditions prevailing on this property and the relatively small size of the targets, it appears advisable to allow sufficient additional footage under stage 2 so that each initial hole of Stage 1 may be offset on a 100-foot grid pattern (figure 3). Stage 2 would then require an additional 123 holes, none to be drilled closer than 100 feet from the boundary lines of the property.

Stage 3: After the completion of stages 1 and 2, the entire tract will have been drilled on a 100-foot grid pattern. According to Paul Melancon, former Chief of the Atomic Energy Commission's office in Grants, prior drilling experience in the district has indicated that about one sixth of the holes drilled on a 100-foot grid pattern can be expected to warrant offsetting. On this basis, if all the 171 holes of stages 1 and 2 were drilled, about 28.5 of this number could be expected to warrant offset holes, spaced 50 feet apart. Assuming that each of these 28.5 holes will require an average of 6 offsets, then stage 3 would consist of 171 holes drilled on a 50-foot offset pattern in the favorable areas indicated by former holes. This estimated amount of drilling constitutes the allowable maximum. For instance, if only 10 of the holes drilled in stages 1 and 2 were considered worthy of offsetting, then stage 3 would consist of but 60 holes. In case stages 1 and 2 found no holes that would justify offsets, then of course, the project would be terminated. None of stage 3 holes should be drilled closer than 50 feet from the property lines. Any unexpended footage in stage 2 should be transferred to stage 3 upon approval of the Field Team.

Once started, rotary drilling will ppoceed very rapidly, perhaps as many as 6 holes being completed daily. Just what constitutes a hole worthy of offsetting may in some cases be a difficult problem. Complications with the drilling contractor will arise if his equipment is idle while awaiting decisions. The highly important sampling procedure may be faulty and questions may arise as to the true depth of some of the holes that have partially caved. To obviate some of the foreseeable difficulties it might be advisable to have a DMEA representative on the job during a large part of the time that the project is under way. Such an arrangement would seem more advisable if 2 DMEA projects were operating in the district at the same time.

The alternative program recommended by the writer is summarized as follows:

Stage 1 - 48 holes on a 200-foot grid;

Stage 2 - 123 holes on a 100-foot offset pattern;

Stage 3 - 171 holes on a 50-foot offset pattern.

Total 342 holes

From figure 3, the distance between the surface and the base of the Todilto limestone was found to average about 37.5 feet. Allowing an additional 3 feet of drilling below the bottom of the limestone to permit probing, the average depth of the holes would be about 40.5 feet. Thus 342 holes would require 13,851 feet of drilling. This amount of exploration would appear adequate for the purpose of disclosing whether or not the property contained worthwhile ore bodies.

If the host limestone underlying the area proposed for exploration averages 20 feet in thickness, then the average depth of overburden would be about 18 feet. For ore found below that amount of overburden, stripping and open-pit mining would be feasible. Under these favorable conditions the mining cost including stripping, as judged from similar operations, would probably not cost more than $8 a ton. If ore averaging 0.20 percent U_3O_8 was found on the property, it would have the following value per ton, f.o.b. mine:

Base price (4 lbs. @ $3.50) --------------	$14.00
Premium (excess over 4 lbs. @ $0.75) ------	None
Development allowance (4 lbs @ $0.50) -----	2.00
Hauling allowance (22 miles @ $0.06) ------	1.32
Total value	$17.32

A bonus amounting to an additional $14.00 a ton would apply on the initial 10,000 pounds of U_3O_8, or in this case on the first 2,500 tons of 0.20 percent ore produced. Thus the average value of the initial 2,500 tons would be $31.32. If a total of 9,000 tons of 0.20 percent ore was found on the property it would have an average value of $21.20. On ore of this value the royalties, consisting of 11 percent to the lessor and 5 percent to the Government, would amount to $3.39 a ton. With operating costs of $8, the resulting profit would be nearly $10 a ton. Hence small ore bodies, under thin overburden, though they contained but a few hundred tons would be profitable and no doubt mined, thus constituting a source of uranium.

It is recognized that an ore body containing but a few hundred tons cannot be considered significant, yet the combined output of all the numerous smaller deposits in the district would be substantial. However, the search for these small average grade deposits by closely spaced drilling is justified only in areas of such shallow overburden as to permit open-pit mining. An experienced operator in the district expressed the opinion that a deposit of average size and grade becomes marginal when covered by more than 35 feet of overburden.

SAMPLING

All the holes drilled under the project should be logged radiometrically and samples collected from the ore-bearing bed as well. An accurate log and the sample results of each hole should be made and recorded by the applicant. In this case the limestone would be sampled in 342 holes by catching the cuttings at each 2-foot interval. If the limestone averaged 20 feet in thickness, 10 samples would be taken from each hole. These samples should be split over a Jones riffle and a representative portion sacked, labeled, and preserved for future checking. The other portion of the sample could be scanned with a calibrated Geiger Counter and those that appeared to be of near ore-grade or better should be assayed.

The applicant proposed assaying all of these samples radiometrically with 20 of the number checked by chemical analyses. It has been shown that the results obtained by radiometric assaying of the limestone ores in the district check very closely with the results obtained by chemical methods. Consequently in this case radiometric assaying of the samples with 20 chemical checks should be satisfactory for the purpose of the proposed exploration.

ESTIMATED COSTS OF THE PROJECT

The applicant proposed that the Four Corners Exploration Co. of Grants be given an independent contract covering all phases of the contemplated exploration. The costs of this complete service as submitted by the above contractor are summarized as follows:

Drilling:

1st 100 feet or any part thereof - \$0.50 a foot
2nd 100 feet or any part thereof - 1.00 a foot
Blowing hole clean and catching cuttings every
2 feet - \$0.50 a foot extra over regular prices.

Radiometric logging and preparation of a permanent geologic record of every hole: - \$0.15 a foot. Supervision, accounting, correspondence, surveying, collection of samples, 20 chemical assays of cuttings, radiometric assay cuttings, geologic mapping and ore reserve calculations: - \$0.15 a foot.

These prices appear reasonable and so far as the drilling is concerned, they are competitive with other contracts in the district.

The average depth of the proposed holes was calculated from the Atomic Energy Commission's topographic map of the area, and structural contours which were based on the presumption that the average dip of the limestone was about 10 feet vertically in 140 feet horizontally (figure 3). From these data the depth of the proposed holes was found to average 37.5 feet. An additional 3 feet of drilling below the base of limestone is desirable in order to afford space for any caving that might occur before the hole could be probed with the radiometric logging device. The applicant desired an extra 5 feet of drilling for this purpose but in the case of such relatively shallow holes it would seem that 3 feet would be sufficient. Thus by allowing 3 feet of extra drilling below the base of the limestone the average depth of the holes would be about 40.5 feet.

Based on the foregoing bid of the Four Corners Exploration Co. the estimated cost of the alternative program would be as follows:

Stage	Grid Pattern	Number of Holes	Depth, Feet	Total Feet	Price per Foot	Cost
1	200 feet	48	40.5	1,944	$0.50	$972.00
2	100 feet	123	40.5	4,981.5	0.50	2,490.75
3	50 feet	171	40.5	6,925.5	0.50	3,462.75
	Totals	342		$13,851.0		$6,925.50

Sampling: 342 holes over 20 ft. thickness = 6,840 ft.	@ $0.50	3,420.00
Radiometric logging - 13,851. ft. @ $0.15		2,077.65
All other costs - 13,851 ft. @ $0.15		2,077.65
Total		$14,500.80
Average cost per foot		$1.05

Working continuously 26 days a month with an average footage of 250 feet per day the drilling could be completed in slightly over 2 months.

PROPOSED FINANCING

The project as estimated by the writer would cost $14,500 of which the applicant would furnish 10 percent, or $1,450 and the Government would provide $13,050.

The ore produced from neighboring properties has averaged about $22 a ton. With ore of this value and a 5 percent royalty the subject property would have to produce about 11,860 tons of ore in order to repay the Government loan. Judged by the information available, the tonnage indicated by the drilling on neighboring properties has averaged about 200 tons of ore per acre. On that basis the 43 acres in question could be expected to yield 8,600 tons of ore. However, because of the unpredictable erratic distribution of the deposits, the subject property could contain more than 8,600 tons, and likewise could contain much less.

CONCLUSIONS AND RECOMMENDATIONS

The productive limestone throughout the area is for the most part completely covered with alluvium or younger sediments so that the only means available for judging the merits of an unexplored tract is its location to known trends and/or its proximity to known ore bodies. The subject property lies within the projected trend of an irregular belt of the Todilto limestone in which ore has been found on neighboring properties and for that reason it is considered worthy of exploration.

The ore-bearing bed underlying the area proposed for exploration is covered with such a thin matte of overburden that any ore found could be mined cheaply in open pits. This would permit the production of uranium from smaller and lower-grade ore bodies.than would be economically feasible where a large amount of stripping or underground mining was necessary. Consequently in areas of shallow overburden, such as the tract in question, there is justification for closely spaced drilling in order to discover as many as possible of the smaller, yet profitable ore bodies.

The applicant proposed to award the drilling contract to the Four Corners Exploration Co. This company is a newly formed organization owned jointly by F. O. Manol and Irving Rapaport, both of Grants, N. Mex.

Rapport is a graduate geologist with about 4 years experience in uranium exploration. He was employed about 3 years of that time by the Atomic Energy Commission as project supervisor in Utah and New Mexico. For the past year he has been managing the exploration and mining operations of the Hanosh Mines, Inc. F. O. Manol, the other partner, has been exploiting a uranium property in the Grants district for the past year and a half with considerable success. The equipment belonging to the Four Corners Exploration consisted of a Failing 1500 mobile rotary drilling rig with auxilliary air compressor and Duclone sampler. A truck mounted radiometric hole logging unit had been ordered and delivery was expedted late in October 1953. Whether or not it is available at this time is not known.

As there appears to be a reasonable chance of finding ore on the subject property it is recommended that a loan amounting to $14,500 be approved. A short form contract is suggested specifying a maximum of 13,850 feet of drilling at a price of $1.05 a foot.

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

August 16, 1954

Memorandum

To: Secretary to the Operating Committee, DMEA

From: Executive Officer, DMEA Field Team, Region IV

Subject: Docket No. DMEA 3152-Hanosh Mines, Inc., McKinley County New Mexico

Reference is made to our letter to the applicant dated July 16, 1954 in which we gave them thirty days to submit approved Assignment of Lease.

We have not heard from the applicant. Therefore, this docket has been closed.

W. H. King

W. H. King

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

August 16, 1954

Memorandum

To: Secretary to the Operating Committee, DMEA

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We have not heard from the applicant. Therefore, this docket has been closed.

W. H. King

W. H. King

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

July 16, 1954.

Mr. George Hanosh, President
Hanosh Mines, Inc.
P. O. Box 338
Grants, New Mexico

Re: Docket No. DMEA-3152

Dear Mr. Hanosh:

We have had no reply to our letter to you dated April 20, 1954 in which we requested the approved assignment of the lease or a photostat of the approved assignment of the lease from D. F. Mollica and George S. Hanosh to Hanosh Mines, Inc.

If we do not receive the approved assignment of the lease within 30 days we will presume that you are no longer interested in the exploration and we will close this docket.

Very truly yours,

W H King

W. H. King
Executive Officer
DMEA Field Team, Region IV

HMC:cwm

cc: Docket
Administrator, DMEA
WMTraver
AHKoschmann
WPWilliams
Chron.

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

July 1, 1954

Mr. George S. Hanosh, President
Hanosh Mines, Inc.
P. O. Box 338
Grants, New Mexico

Re: DMEA Docket 3152 (Uranium), Hanosh Mines, Inc., McKinley County, New Mexico

Dear Mr. Hanosh:

Reference is made to our letter of April 20, 1954, a copy of which is enclosed.

To date, we have not heard from you in regard to the requested assignment of lease.

If we do not hear from you concerning this matter by August 9, 1954, we will consider that you are no longer interested in the Defense Minerals Exploration program and will close your application.

Very truly yours,

W. H. King
Executive Officer
DMEA Field Team
Region IV

Enclosure

RDB:es
cc: Docket 3152
Administrator DMEA
Williams
Traver
Koschmann
Chron.

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

April 20, 1954.

Mr. George S. Hanosh, President
Hanosh Mines, Inc.
P. O. Box 338
Grants, New Mexico

Re: Docket No. DMEA-3152

Dear Mr. Hanosh:

This replies to your letter of April 16, 1954 informing us that D. F. Mollica and George Hanosh are the sole owners of Hanosh Mines, Incorporated.

The mining lease on allotted Indian lands, which is the subject of your Defense Minerals Exploration Administration application, was issued to two individuals, George S. Hanosh and D. F. Mollica. The DMEA application for exploration assistance was made in the name of Hanosh Mines, Inc., a New Mexico corporation.

If the exploration project contract is to be awarded to Hanosh Mines, Inc., George S. Hanosh and D. F. Mollica must assign the lease made to them, as individuals, to Hanosh Mines, Inc.

Please refer to paragraph 3(g) of your mining lease which specifies - "Not to assign this lease or any interest therein by an operating agreement or otherwise, nor to sublet any portion of the leased premises before restrictions are removed, except with the approval of the Secretary of the Interior."

Before we can process the contract we must have the approved assignment of the lease or a photostat of the approved assignment of the lease from D. F. Mollica and George S. Hanosh to Hanosh Mines, Inc.

Very truly yours,

John F. Shaw

John F. Shaw
For W. H. King
Executive Officer
DMEA Field Team, Region IV

HMC:cwm

cc: Docket
Administrator, DMEA
WMTraver
AHKoschmann
RPFischer
Chron.
HMConnors

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UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

March 19, 1954

Mr. George Hanosh, President
Hanosh Mines, Inc.
P.O. Box 338
Grants, New Mexico

Re: Docket DMEA 3152

Dear Mr. Hanosh:

The mining lease on the NE¼ Sec. 22, T. 13 N., R. 10 W., was issued to George Hanosh and D.F. Mollica as individuals. The DMEA application was made in the name of Hanosh Mines, Inc., a New Mexico corporation.

Paragraph 3(g) of the lease specifies "Not to assign this lease or any interest therein by an operating agreement or otherwise, nor to sublet any portion of the leased premises before restrictions are removed, except with the approval of the Secretary of the Interior."

If the Exploration Project Contract is to be awarded to Hanosh Mines, Inc. as operator please furnish this office with the approved assignment of the lease from George Hanosh and D.F. Mollica to Hanosh Mines, Inc.

When we receive the approved assignment of the lease or a photostat of the approved assignment of the lease we will continue to process the contract.

Very truly yours,

W. H. KING

W. H. King
Executive Officer, DMEA
Field Team, Region IV

HMC:jp
cc Subject
Chron
COMittendorf
WMTraver
RPFischer
AHKoschmann
HMConnors

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D.C.

224 New Customhouse
Denver 2, Colorado

March 3, 1954.

Memorandum

To: Administrator, Defense Minerals Exploration Administration
Attention: 200

From: Field Team, Region IV

Subject: Report of Examination - DMEA Docket 3152 (Uranium), Hanosh Mines, Inc., McKinley County, New Mexico.

Exploration assistance in the amount of $13,851.00 has been approved and a contract will be prepared by this office.

Four copies of the report of examination will be forwarded you when the contract is executed.

The original and one copy of Form 3b are attached.

W H King
W. H. King

A. H. Koschmann
A. H. Koschmann

Enclosures

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D.C.

224 New Customhouse
Denver 2, Colorado

March 3, 1954.

Memorandum

To: Administrator, Defense Minerals Exploration Administration
Attention: 200

From: Field Team, Region IV

Subject: Report of Examination - DMEA Docket 3152 (Uranium), Hanosh Mines, Inc., McKinley County, New Mexico.

Exploration assistance in the amount of $13,851.00 has been approved and a contract will be prepared by this office.

Four copies of the report of examination will be forwarded you when the contract is executed.

The original and one copy of Form 3b are attached.

W H King
W. H. King

A. H. Koschmann
A. H. Koschmann

Enclosures

DMEA Form 3b
(Revised)

DEFENSE MINERALS EXPLORATION ADMINISTRATION

CONTROLLED DOCUMENT
Revised Abstract

DMEA Docket No. 3152

Name of Applicant Hanosh Mines, Inc.

Change:	From		To	
	III 1	[ ]	III 1	[x] 2-26-52
	III 2	[ ]	III 2	[ ]
	III 3	[ ]	III 3	[ ]
	III 4	[x]	III 4	[ ]
	III 5	[ ]	III 5	[ ]
			III 6	[ ]
			III 7	[ ]

Add:
II 7 $ 26,460.69
II 8 $ 13,851.00
II 8a %
II 9 $

Remarks:

Initials of person preparing sheet H.M.C.

Date sheet prepared 2-26-52

33978

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DMEA Form 3b
(Revised)

DEFENSE MINERALS EXPLORATION ADMINISTRATION

CONTROLLED DOCUMENT
Revised Abstract

DMEA Docket No. 3152

Name of Applicant Hanosh Mines, Inc.

Change:	From			To		
	III	1	☐	III	1	☒ 2-26-52
	III	2	☐	III	2	☐
	III	3	☐	III	3	☐
	III	4	☒	III	4	☐
	III	5	☐	III	5	☐
				III	6	☐
				III	7	☐

Add: II 7 $ 26,460.69

II 8 $ 13,851.00

II 8a % ______

II 9 $ ______

Remarks:

Initials of person preparing sheet H.M.C.

Date sheet prepared 2-26-52

33978

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D.C.

224 New Customhouse
Denver 2, Colorado

February 26, 1954.

Hanosh Mines, Inc.
Box 447
Grants, New Mexico

Re: Docket No. DMEA-3152

Gentlemen:

In preparing a contract for exploration work on your property it will be necessary for us to know in which state Hanosh Mines is incorporated. We will also require a signed copy of your lease or a photostat of a signed copy of the lease.

When this information is received by this office, we will be pleased to continue to process the contract.

Very truly yours,

W. H. King

W. H. King
Executive Officer
DMEA Field Team, Region IV

HMC:cwm

cc: Docket
Administrator, DMEA
WRStorms
AHKoschmann
Chron.
HMConnors

MF-103
(Revised April 1952)

UNITED STATES DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION

Form Approved.
Budget Bureau No. 42-R1035.2.

APPLICATION FOR AID IN AN EXPLORATION PROJECT, PURSUANT TO DMEA ORDER 1, UNDER THE DEFENSE PRODUCTION ACT OF 1950, AS AMENDED

Not to be filled in by applicant

Docket No. DMEA-3152
Metal or Mineral
Date Received 8/31/53
Estimated Cost
Participation (Government %)

INSTRUCTIONS

1. *Name of applicant.*—(*a*) State here your full legal name, in the form in which you will wish to contract, and your mailing address: Henosh Mines, Incorporated. Box 447, Grants, New Mexico.

(*b*) If other than an individual, add to your name above whether a corporation, partnership, etc., and the name of the State in which incorporated or otherwise organized.

(*c*) If a corporation, add to above statement, titles, names and addresses of officers.

(*d*) If a partnership, add to the above statement the names and addresses of all partners.

2. *General.*—Read DMEA Order 1, "Government Aid in Defense Exploration Projects," before completing this application. Submit this application and all accompanying papers in quadruplicate (four copies), with your name and address on each sheet of the application and on all accompanying papers. Where sufficient space is not provided on the form for all required information, state it on an accompanying paper, with a reference in each case to the instruction to which it refers by number. Comply with all applicable instructions; or, if not applicable, so state. File the application with Defense Minerals Exploration Administration, Department of the Interior, Washington 25, D. C., or with the nearest field executive officer thereof.

3. *Applicant's property rights.*—(*a*) State the legal description of the land upon which you wish to explore, including all land which you possess or control that may be benefited by the exploration, and excluding any land or interest in land which is not to be included in the exploration project contract Northeast 1/4, Section 22, Township 13 North, Range 10 West, McKinley County, New Mexico.

(*b*) State any mine name by which the property is known. none

(*c*) State your interest in the land, whether owner, lessee, purchaser under contract, or otherwise The property is an Indian allotment held under lease by Henosh Mines, Inc..

(*d*) If you are not the owner, submit with this application a copy of the lease, contract, or other document under which you control the property.

(*e*) If you own the land, describe any liens or encumbrances on it

(*f*) If the land consists of unpatented claims, add to the description above, the book and page numbers for each recorded location notice.

4. *Physical description.*—(*a*) Describe in detail any mining or exploration operations which have been or now are being conducted upon the land, including existing mine workings and production facilities. State your interest, if any, in such operations. Also describe accessibility of mine workings for examination purposes.

(*b*) State past and current production, and ore reserves, if any, giving quantities and grades.

(*c*) Describe the geologic features of the property, including mineralization, type of deposit (vein, bedded, etc.), and your reasons for wishing to explore. Illustrate with maps or sketches. Send with your application (but not necessarily as a part of it) any geologic or engineering report, assay maps, or other technologic information you may have, indicating on each whether you require its return to you.

(*d*) State the facts with respect to the accessibility of the project: Access roads, distances to shipping, supply and residence points.

(*e*) State the availability of manpower, materials, supplies, equipment, water, and power.

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5. *The exploration project.*—(a) State the [redacted]eral or minerals for which you wish to explo[redacted]ranium

(b) Describe fully the proposed work, including a map or sketch of the property showing a plan (and cross sections if needed) of any present mine workings, and the location of the proposed exploration work as related to such features as contacts, veins, ore-bearing beds, etc.

(c) The work will start within 30 days and be completed within 3 months from the date of an exploration project contract.

(d) State the operating experience and background of the applicant with relation to the ability to carry out such exploration project, and also that of the person or persons who will supervise the operations.

6. *Estimate of costs.*—Furnish a detailed estimate of the costs of the proposed work (you will have to use a separate sheet), under the following headings. Add the totals under all headings to give the estimated total cost of the project:

(a) *Independent contracts.*—(Note.—If the applicant does not intend to let any of the work to contractors, write "none" after this item. To the extent that the work is to be contracted, do not repeat the cost of the contract-work in subsequent items.) State the cost of any proposed independent contracts for the performance of all or any part of the work, expressed in terms of units of work (such as per foot of drilling, per foot of drifting, per hour of bulldozer operations, per cubic yard of material moved, etc.).

(b) *Labor, supervision, consultants.*—Include an itemized schedule of numbers, classes and rates of wages, salaries or fees for necessary labor, supervision and engineering and geological consultants.

(c) *Operating materials and supplies.*—Furnish an itemized list, including items of equipment costing less than $50 each, and power, water and fuel.

(d) *Operating equipment.*—Furnish an itemized list of any operating equipment to be rented, purchased, or which is owned and will be furnished by the Operator, with the estimated rental, purchase price, or suggested use-allowance based on present value, as the case may be.

(e) *Rehabilitation and repairs.*—Furnish a detailed list showing the cost of any necessary initial rehabilitation or repairs of existing buildings, installations, fixtures, and movable operating equipment, now owned by the Operator and which will be devoted to the exploration project.

(f) *New buildings, improvements, installations.*—Furnish a detailed list showing the cost of any necessary buildings, fixed improvements, or installations to be purchased, installed or constructed for the benefit of the exploration project.

(g) *Miscellaneous.*—Furnish a detailed list showing the cost of repairs to and maintenance of operating equipment (not including initial rehabilitation or repairs of the Operator's equipment), analytical work, accounting, workmen's compensation and employers' liability insurance, and payroll taxes.

(h) *Contingencies.*—Give an estimate of any necessary allowances for contingencies not included in the costs stated above.

NOTE.—No items of general overhead, corporate management, interest, taxes (other than payroll and sales taxes), or any other indirect costs, or work performed or costs incurred before the date of the contract, should be included in the estimate of costs.

7. (a) Are you prepared to furnish your share of the cost of the proposed project in accordance with the regulations on Government participation (Sec. 7, DMEA No. 1)?

(b) How do you propose to furnish your share of the costs?

/ ☐ Money ☐ Use of equipment owned by you ☐ Other

Explain in detail on acompanying paper.

CERTIFICATION

The undersigned, whether as an individual, corporate officer, partner, or otherwise, both in his own behalf and acting for the applicant, certifies that the information set forth in this form and accompanying papers is correct and complete, to the best of his knowledge and belief.

Dated August 3, 195

Hanosh & Mollica
(Applicant)

By George H Hanosh

Title 18, U. S. Code (Crimes), Section 1001, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

U. S. GOVERNMENT PRINTING OFFICE 16—66551-1

1. b) Incorporated in New Mexico

c) President --- George S. Hanosh, Box 447, Grants, N.M.
Treasurer --- Annabelle Hanosh, Box 447, Grants, N.M.
Secretary --- D. F. Mollica, Gallup, N.M.

4. a) This property, in McKinley County, New Mexico, may be reached in the following manner: 1) Travel three miles west on U.S. #66 from the town of Grants; 2) Turn north on U.S. #53 (the San Mateo Road) and go eleven miles along the valley floor. This road then ascends a gently sloping portion of the Entrada Sandstone scarp for approximately a mile and descends upon the broad Todilto Limestone bench: 3) Turn northwest at a well constructed cattle-guard and follow the most prominent graded road past numerous open pit and underground uranium operations for approximately four miles.

It has taken the Indian Service approximately two years to sign this lease. Therefore, only geologic mapping and sampling and no physical development has been completed.

b) No production.

c) Geologic Reasons for Wishing to Explore the N.E. ¼ of Sect. 22.

1) Favorable Location

Virtually all of the large mines and blocked out ore bodies of the Grants District are situated between Haystack Butte and Grants Mesa, a distance of about 13 miles. (fig. 1) The extension of this apparent mineral belt for fourty miles to the northwest, contains scattered prospects. No major deposits have been developed in this direction. Southeast of Grants Mesa, for approximately fourty miles, numerous uranium showings have also been discovered. With the exception of the Jackpile Mine of Anaconda, no appreciable tonnage has been developed. The property for which aid is asked is situated in the central portion of the main productive area. It lies squarely across the apparent mineral belt. The only adjacent property which has been explored, Santa Fe's Section23, contains about 30,000 tons of uranium ore.

2) Ease of Exploration

The two major ore horizons in this district are the Todilto limestone and the Morrison formation. The Morrison formation is assuming greater economic importance, but the bulk of developed ore lies within the Todilto limestone.

One of the major reasons for the rapid development of the Grants District is the ease with which the Todilto limestone may be explored. The limestone is the most resistant rock in the Jurassic section and forms a gently dipping bench (4°) under shallow cover for as much as a half mile back from the Entrada sandstone rim. This feature is well demonstrated by the fact that the deepest hole proposed on this property, 1700 feet back from the rim, has but 49 feet overburden to penetrate. The 43 feet average depth of hole consists of 18 feet of overburden, 20 feet of limestone, and 5 feet of underlying sandstone. More of the ore horizon is examined per dollar of exploration than any other area of carnotite-type deposits.

3) High-grade ore

The uranium minerals of the blanket-type ore deposits initially mined in Todilto limestone, on or close to the rim, consisted of carnotite, tyuyamunite, and uranophane, with limonite, hematite, and coarsely-crystalline calcite. At depth, away from the rim, the above oxide-type minerals are in lesser amount and larger amounts of pitchblende, fluorite, barite, and pyrite are discernable. Two showings of carnotite are present along the rim of Section22 and an ore-grade prospect is situated in an arroyo near the north line of this section. (fig. 2)

d) Section 22 is 22 miles by road from the Anaconda Copper Mining Co. mill at Bluewater, New Mexico. Fifteen miles of improved and maintained road lead from the property to the main line of the Santa Fe Railway and U.S. #66. It is 7 miles on U.S. #66 to the mill from this point. The town of Grants is 13 miles from this property.

e) An abundant supply of cheap labor is available in this area. The Navajo Indians are excellent for mucking and hand sorting. The shut-down of the fluorite mines in this area has provided a surplus of skilled miners. Powder, hardware, timber, and truck parts are available at Grants. Inexpensive fuel can be obtained at the Prewitt oil refinery close to the mill site. Almost all mining machinery firms maintain dealerships at Albuquerque, 80 miles east of Grants over U.S. #66. A water well is present on Section 22.

5. b) Figure 2 illustrates the desired work. It is proposed that an initial 100 foot grid of 207 holes, averaging 43.08 feet in depth, be completed first. The disposition of holes on 50 and 25 foot centers shall be determined by the results obtained by the initial grid. Approximately 20% of the holes drilled in the central portion of the Grants District have shown gamma ray counts about three times that of the background count of the hole. Applying this ratio, (see fig. 3), 285.66 offset holes on 50 foot centers are anticipated. Ten percent of the holes on 50 foot centers contained .05% U_3O_8 or better. On this basis, 213.25 holes on 25 foot centers are anticipated. Several of the mine owners in this district prefer to continue their search for ore on 10 foot centers. It is our opinion that the large additional expense is not warranted by the small pods of uranium found in this manner. (For summary of proposed drilling see Table 1.)

It is proposed that reliance be placed on radiometric logging for holes on 100 and 50 foot centers. (see sheet on the value of radiometric logging.) ~~The A.E.C. has a logging truck in this area and has volunteered to perform the service without charge.~~ The cuttings from the 20 feet of limestone in holes on 25 foot centers shall be collected at two foot intervals and the portions of these cuttings which show abnormal radioactivity shall be radiometrically assayed. To definitely check the uranium values obtained by probing and radiometric assaying, twenty random chemical assays shall be run on cuttings.

d) It is proposed that the Four Corners Exploration Company, of Grants, New Mexico, undertake all drilling, geologic work, surveying, accounting, and supervision involved in this program. Mr Irving Rapaport, co-owner of the Four Corners Exploration Co. and the proposed supervisor of this program has had the following experience.

Chronologically:

Miner - Evergreen Mining Company, Coleraine, Minn.	3 months
" - Climax Molybdenum Co., Climax, Colo.	9 "
" - Golden Cycle Corp., Cripple Creek, Colo.	1 "
" - Sunshine Mining Co., Wallace, Idaho	3 "
Bachelors in Geologic Engineering, U. of Minnesota	1949
Geologist A.E.C. Exploration Projects	
Calamity Mesa, Colo.	9 "
Project Supervisor A.E.C. Exploration Projects	
Marysvale, Utah	9 "
Grants, New Mexico	15 "
Manager, Hanosh Mines, Inc.	15 "
Consultant Geologist	Total of
Chilean Nitrate Corporation	110 days at
J.H. Whitney Enterprises	$100.00 per
Spencer Chemical Co.	day

6. a) It is proposed that all drilling be done by a Failing 1,500 rotary rig at the rate of $.50 per foot by the Four Corners Exploration Company. The approximate cost of previous exploration cost in this area is:

Type	Company	Cost
Core drilling	Anaconda	$2.15 per foot
Wagon drilling	Santa Fe R.R.	$.90 " "
" "	Anaconda	$.90 " "
" "	Hanosh Mines, Inc.	$.95 " "
" "	Lamel and partners	$1.05 " "

The A.E.C. has let a contract to the low bidder for rotary drilling in this area at $.573 per foot. The previous low unit cost for A.E.C. exploratory drilling was the wagon drilling contract at Temple Mountain, Utah, at $.93 per foot.

For that minor proportion of the drilling where sample is desired a cost of $1.00 per foot is bid.

An additional cost of $.15 per foot has been added to cover the cost of geologic work, radiometric assays of the cuttings, 20 check chemical assays, surveying, accounting, correspondence, and supervision. (For tabulation of drilling, see Table I).

The A.E.C. has stated that its radiometric logging truck is to be used primarily for its own drilling, and may not be available for private exploration. A truck-mounted radiometric logging unit, somewhat inferior to that employed by the A.E.C. is to be bought for use on this program. An additional $.15 per foot is proposed for this service.

b), c), d), e), f), g), and h).

The individual items of expense are not listed as a per unit basis is being employed in this bid.

The equipment to be used on this job includes;

Item	Approximate Cost New
1 Failing rotary drilling rig (1,500' rated capacity)	$27,000.00
1 Ingersol Rand Gyroflow Compressor (315 c.f.m.)	8,200.00
1 S.D. Duclono sampler	500.00
1 Chevrolet truck for compressor (1½ ton)	3,200.00
2 Pickup trucks (½ ton)	3,900.00
1 Truck-mounted radiometric logging unit	3,500.00
Total	$45,700.00

7. a) Kenoch Mines, Inc. is fully prepared to furnish its share of the cost of the proposed project in accordance with the regulations on Government participation.

b) Kenoch Mines, Inc. share of the expense of exploration will be provided in money.

Table 1

SUMMARY OF DRILLING

SECTION 22, T 13 N, R 10 W.

Phase	No. Holes	Avg. Depth	Total Feet	Cost/Ft.	Total Cost
Initial Grid (100')	207	43.03*	8,919	$.50	$4,459.00
Secondary Grid (50')**	285.66	43.03	12,305.43	$.50	$6,152.715
Tertiary Grid (25')***	213.25	43.03			
a) Limestone Cuttings received		20.00	4,265.00	$1.00	$4,265.00
b) Overburden		23.03	4,921.61	$.50	$2,460.805
Totals	705.91	43.03	30,410.24	$.570	$17,337.520

Radiometric logging and the preparation of a permanent geologic record of every hole ———————————— 30,410.24' @ $.15/ft.=$4,561.536

Supervision, rental time, correspondence, surveying, collection of cuttings, twenty chemical assays of cuttings, radiometric assays of cuttings, geologic mapping, and ore reserve calculations.
30,410.24' @ $.15/ft.=$4,561.536

Total maximum cost of exploration program $26,460.592

* Average hole is composed of:
    18.03 feet of overburden (alluvium, siltstone, and shale)
    20.00 " " limestone (ore horizon)
    5.00 " " sandstone (underlying Entrada sandstone)

** The ratio developed in figure 3, assuming 20% of holes on the initial grid to be mineralized, was applied to yield a total of 285.66 holes on the secondary grid.

*** The ratio developed in figure 3, assuming 10% of holes on the secondary grid to yield chemical ore, was applied to obtain the figure of 213.25 holes on the tertiary grid.

[illegible]

[illegible]

1) An exact, continuous, and permanent record of the intensity of radio activity of every inch of the hole is produced.

2) The extreme sensitivity of this method presents two major advantages.

a) [illegible] can be differentiated by their relative inherent radioactivity. [illegible]

b) A large [illegible] of [illegible] mineralization [illegible]

3) The exact thickness of ore is defined.

4) The [illegible] is able to decide where to drill [illegible] immediately.

5) The overall cost of exploration is reduced.

a) The volume of drilling required by the [illegible] is reduced.

b) [illegible] eliminates [illegible] of the expense of [illegible].

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS
EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE TO AVOID
PAYMENT OF POSTAGE, $300
(PMGC)

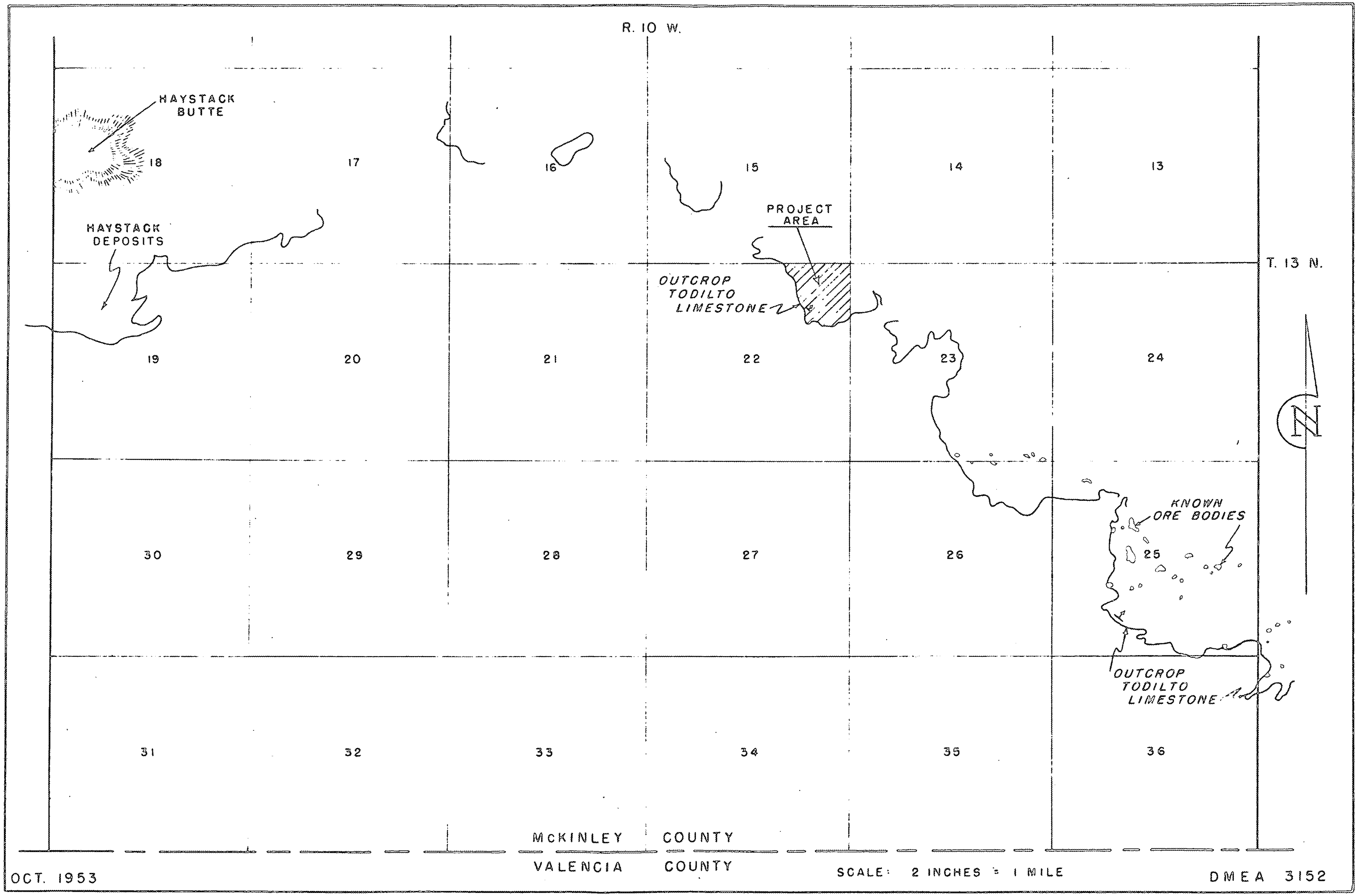


FIGURE 2. - OUTCROPS OF TODILTO LIMESTONE

HANOSH MINES, INC. (SHOWING SOME OF THE KNOWN ORE BODIES) McKINLEY COUNTY, NEW MEXICO

The area proposed for exploration covers about 43 acres situated in the extreme northeast corner of Sec. 22. The land in Secs. 15 and 23, which immediately adjoins the subject property on the north and east, is either owned or controlled by the Atchison, Topeka & Santa Fe Railway Co. (figure 3). The applicant company is producing ore from another lease covering a portion of Sec. 26, T. 13 N., R. 10 W.

DESCRIPTION OF THE DEPOSITS

Uranium mineralization in the area under consideration occurs in the Todilto limestone. This formation is a persistent gently-dipping bed averaging about 20 feet in thickness. The tract proposed for exploration is underlain by this limestone. Its irregular outcrop marks the western and southern boundaries of the project area (fig. 3). Erosion has completely removed the Todilto limestone from all of Sec. 22 with the exception of the extreme northeastern corner which constitutes the area proposed for exploration. Except in the immediate vicinity of the outcrop the favorable bed is usually completely concealed by varying thicknesses of overburden. This is not only true of the tract under consideration but prevails generally throughout the district. Although showings of uranium mineralization are not uncommon along the outcrop of the Todilto it appears that very few of the district's more important ore bodies have been found exposed in this manner. Closely spaced blind drilling has been the chief means of finding and outlining the present ore reserves of the district.

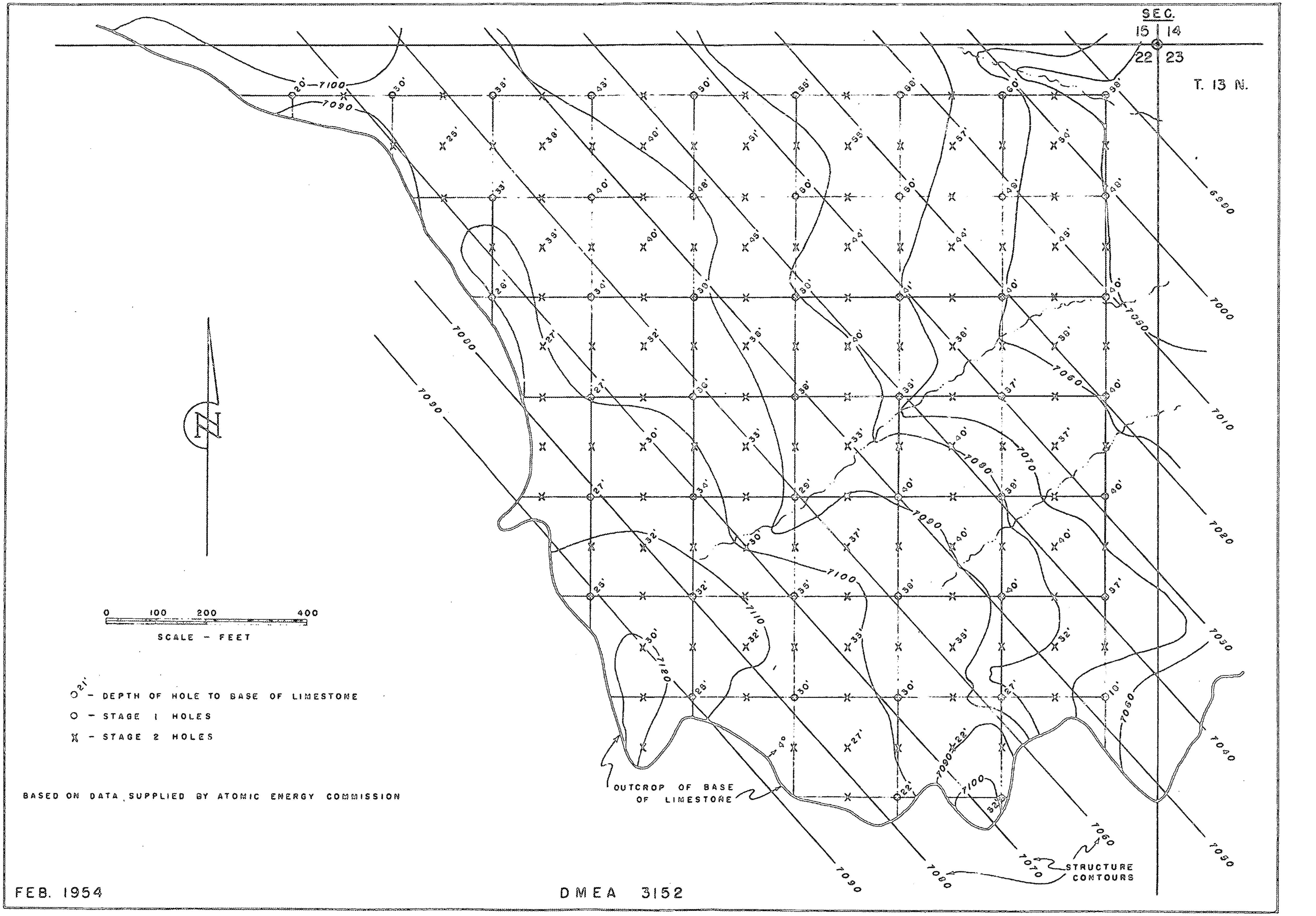


FIGURE 3. - TOPOGRAPHIC AND STRUCTURAL CONTOUR MAP

HANOSH MINES, INC. (SHOWING STAGE 1 AND 2 OF PROPOSED DRILLING) McKINLEY COUNTY, NEW MEXICO

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DEFENSE MINERALS EXPLORATION ADMINISTRATION
DOCKET 3152

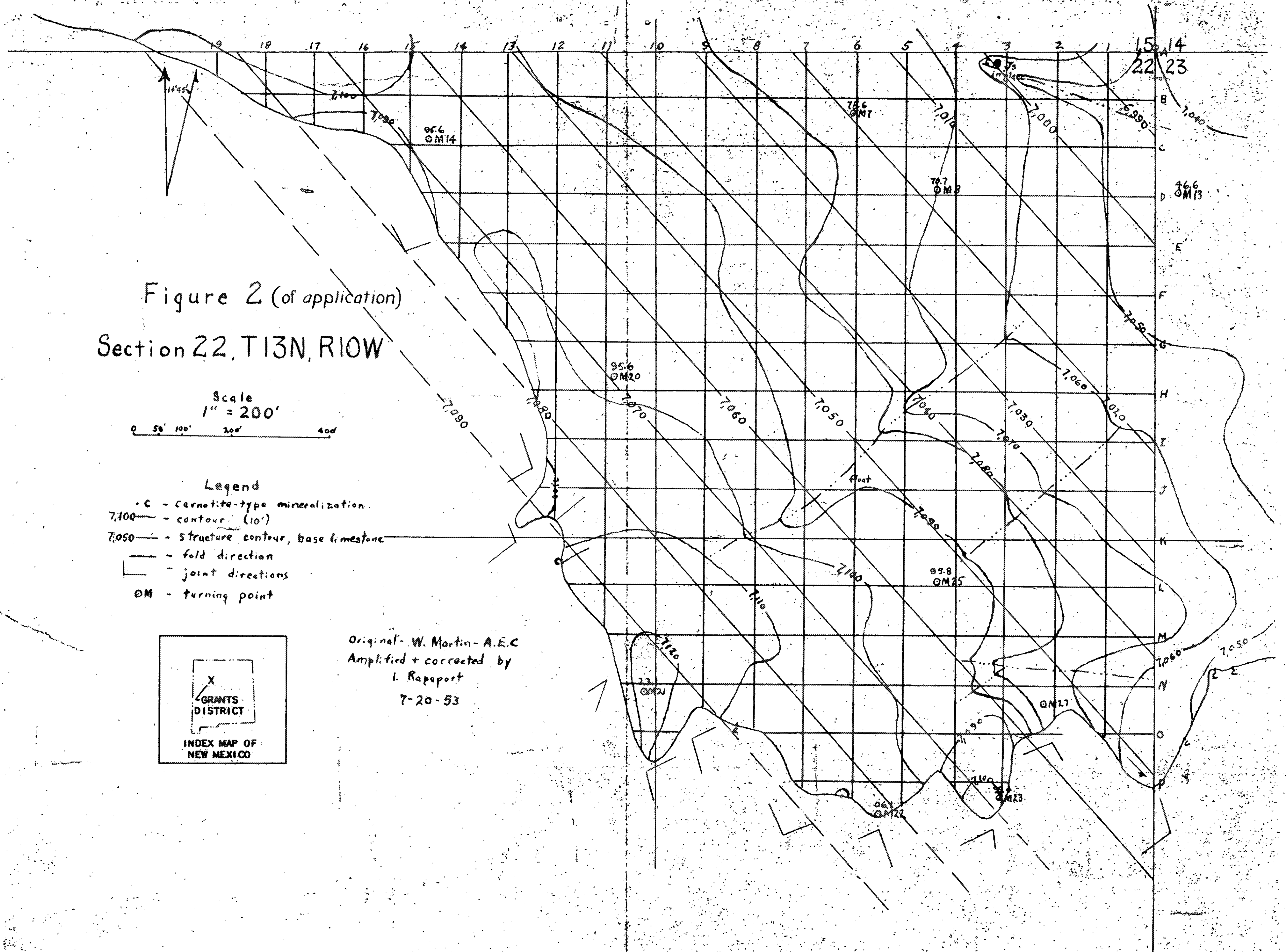
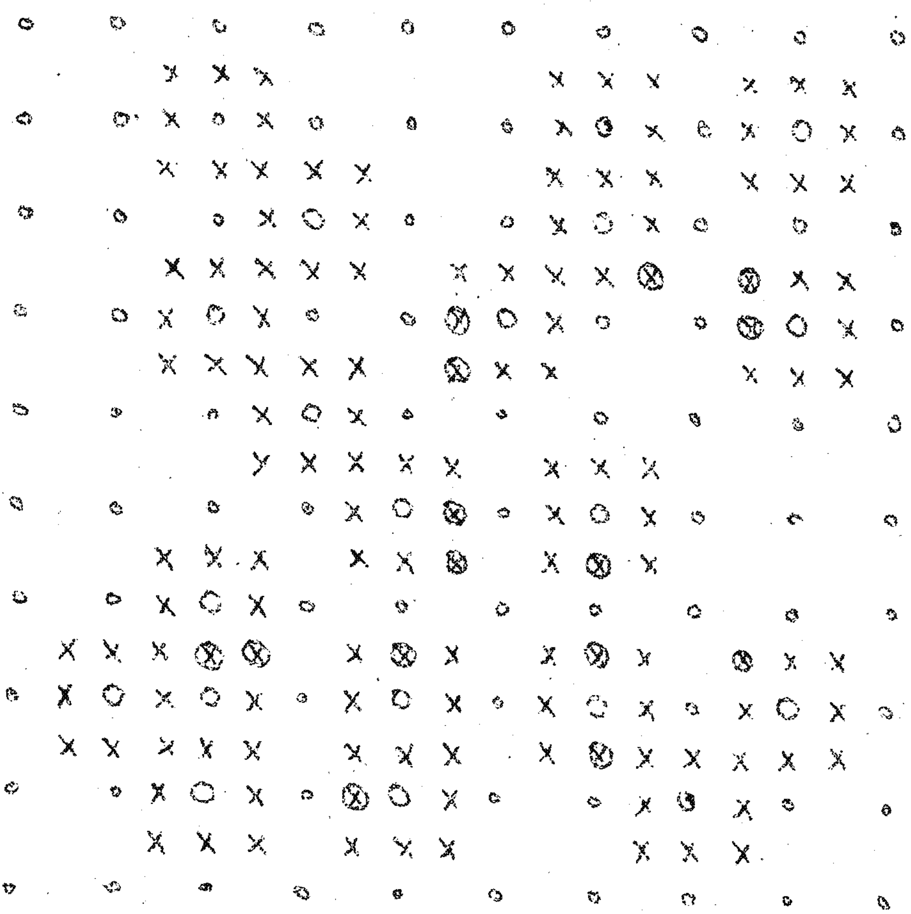


Figure 1. INITIAL DRILLING PATTERN, SUGGESTED BY APPLICANT, HANOSH MINES INC., GRANTS DISTRICT, McKINLEY COUNTY, NEW MEXICO

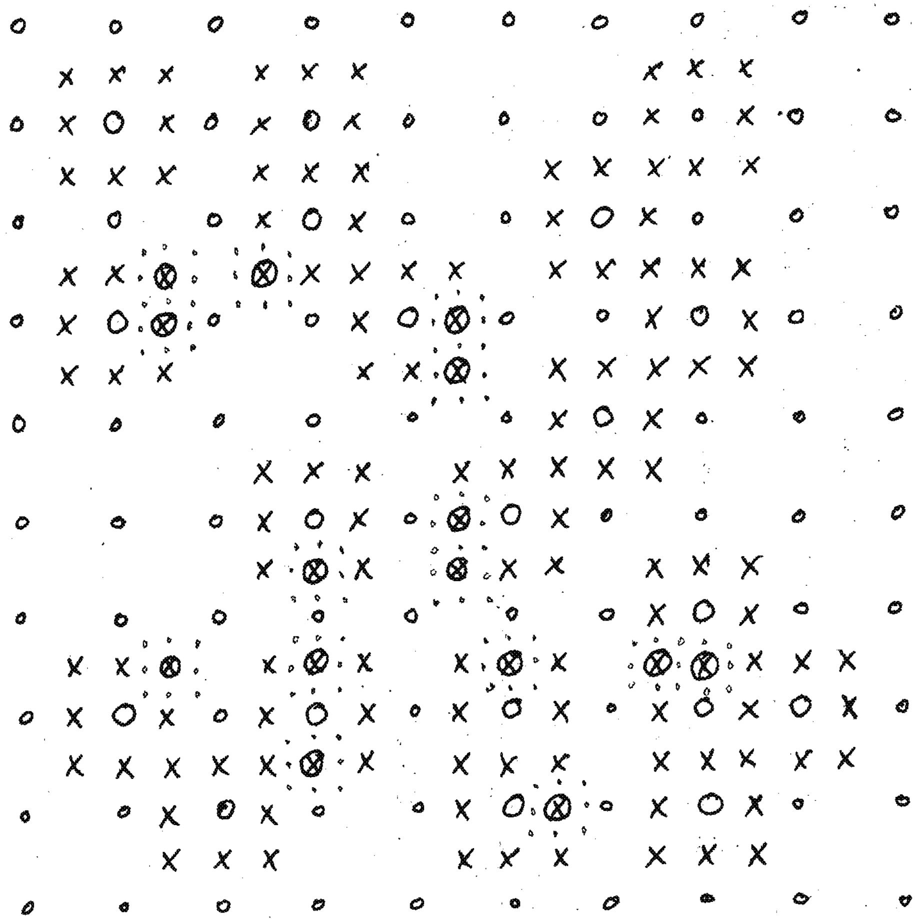
Figure 3



1) o 100 holes initial (100') grid
O 20% (20) " mineralized (3X background)
2) X 138 " secondary (50') grid required
⊗ 10% (13.8) " mineralized (approaching ore grade) (150 c/s = .09% U_3O_8)
3) 103 " tertiary (25') grid required

L. Rapaport
8-6-53

Figure 3



D MGA-3152

1) o 100 holes initial (100') grid

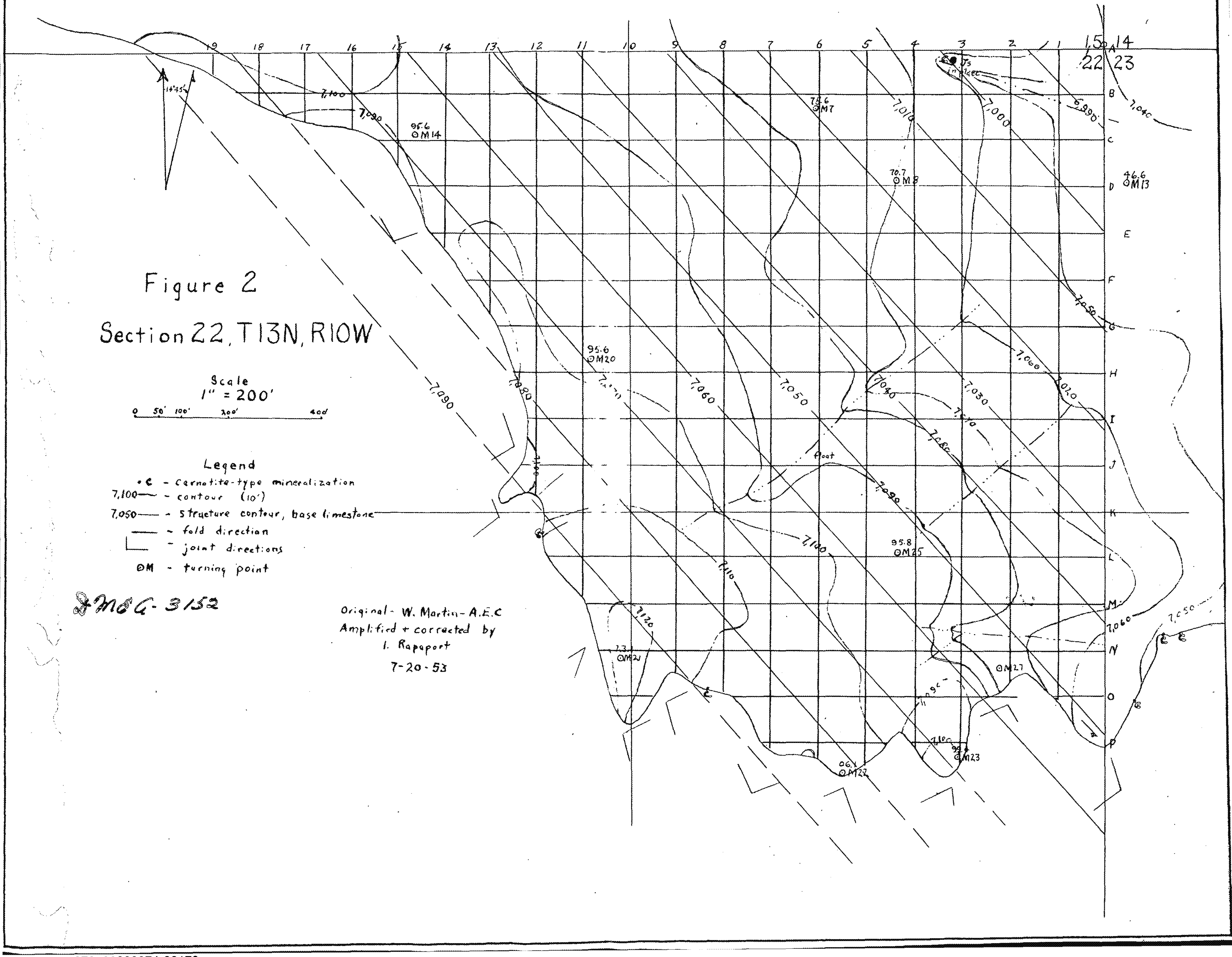
O 20% (20) " mineralized (3X background)

2) X 138 " secondary (50') grid required

⊗ 10% (13.8)" mineralized (approaching ore grade) (1,500 c/s = .04% U_3O_8)

3) · 103 " tertiary (25') grid required

I. Rapaport
8-6-53



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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DEFENSE MINERALS EXPLORATION ADMINISTRATION
DOCKET 3152

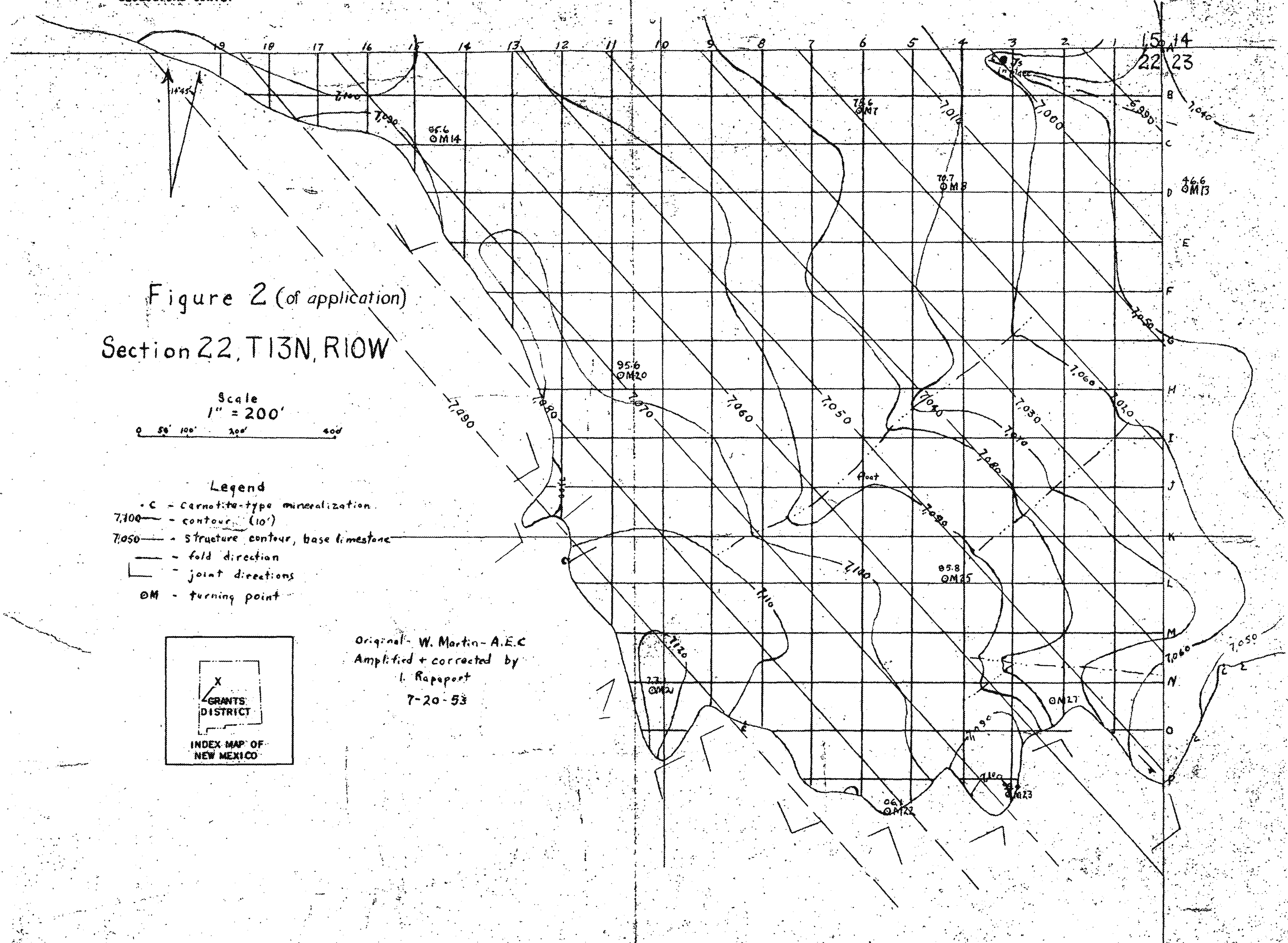

Figure 1. INITIAL DRILLING PATTERN, SUGGESTED BY APPLICANT, HANOSH MINES INC., GRANTS DISTRICT, McKINLEY COUNTY, NEW MEXICO

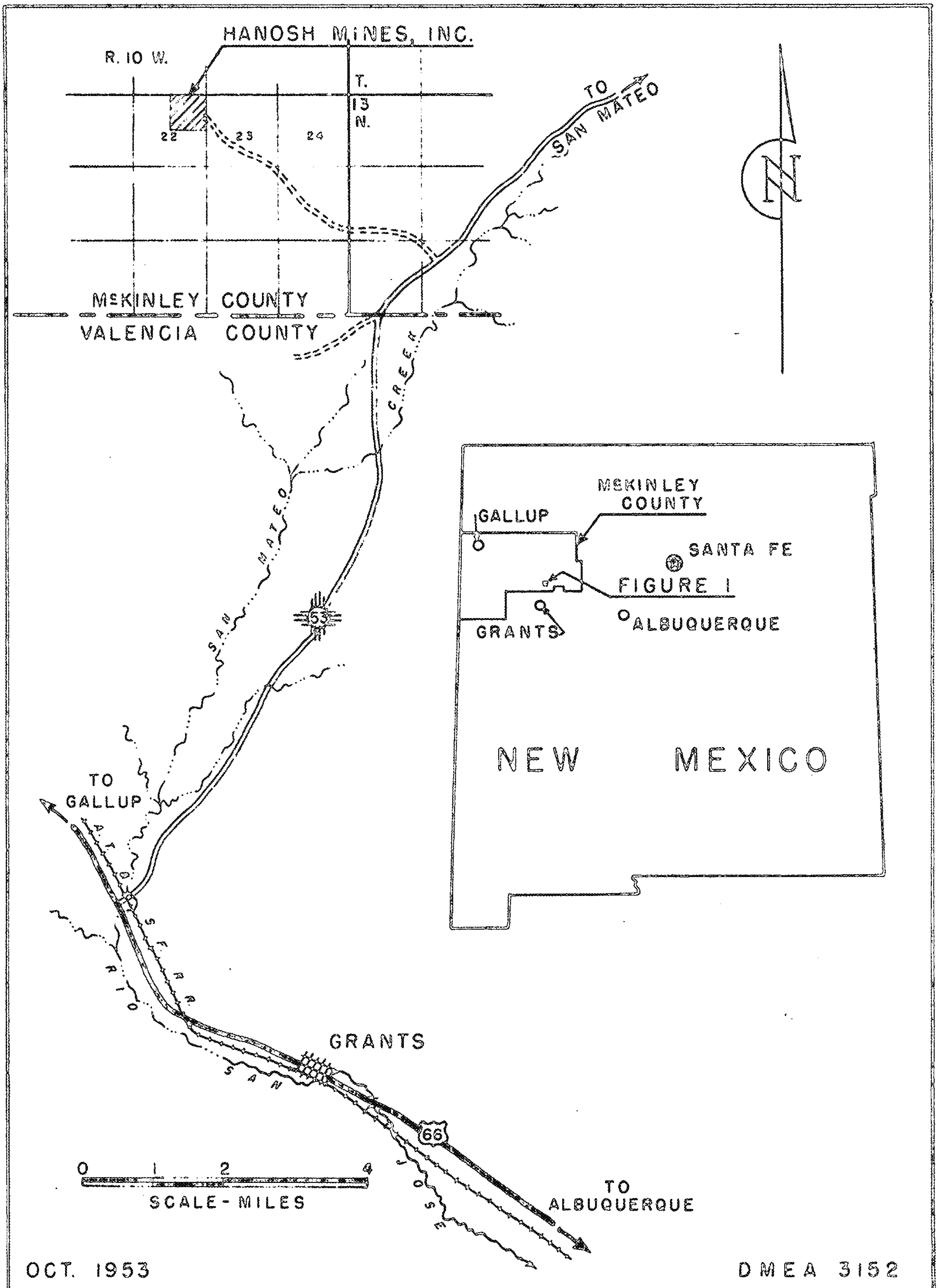

FIGURE I, - LOCATION MAP - HANOSH MINES, INC.
McKINLEY COUNTY, NEW MEXICO

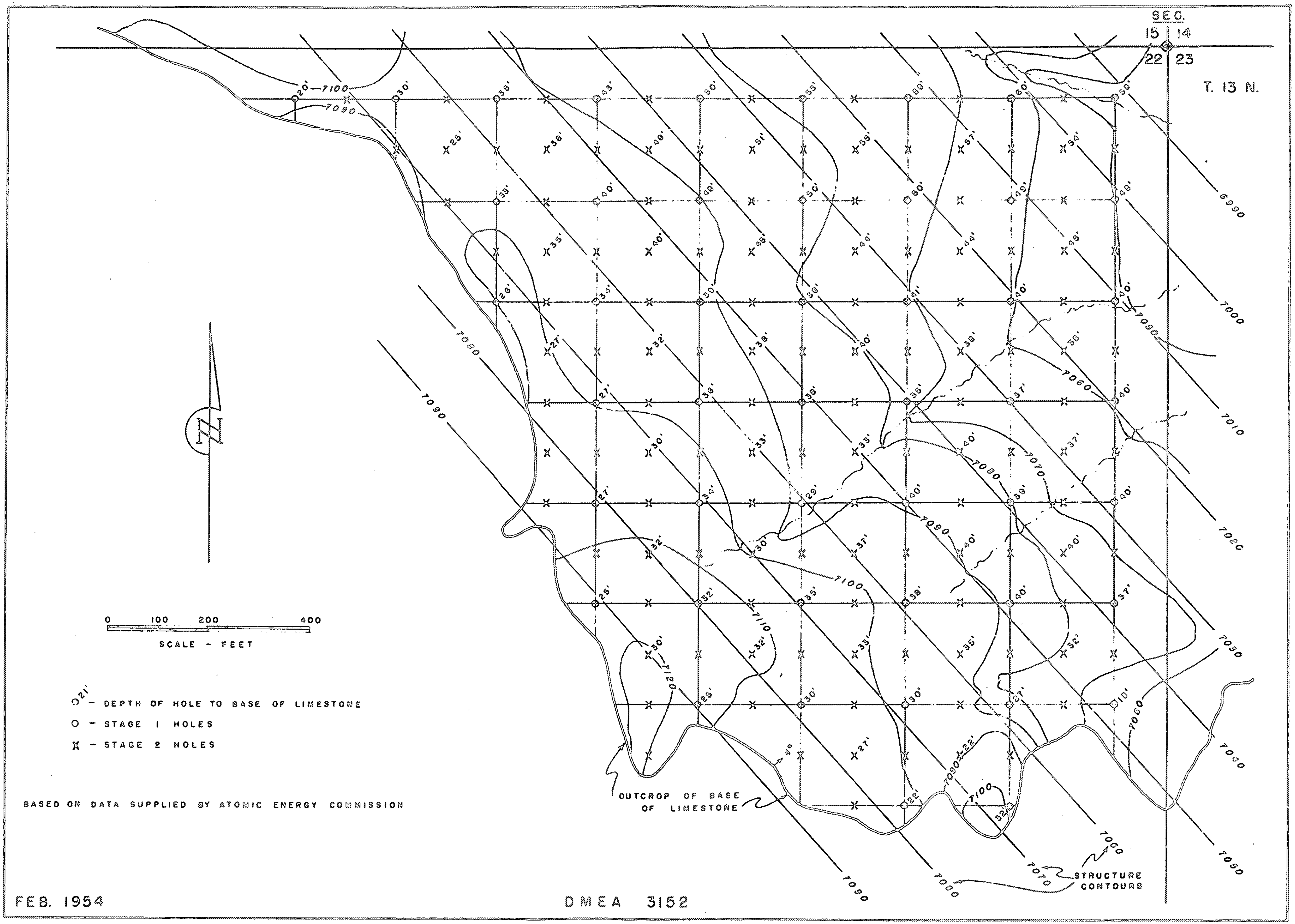

FIGURE 3. - TOPOGRAPHIC AND STRUCTURAL CONTOUR MAP

HANOSH MINES, INC. (SHOWING STAGE 1 AND 2 OF PROPOSED DRILLING) McKINLEY COUNTY, NEW MEXICO

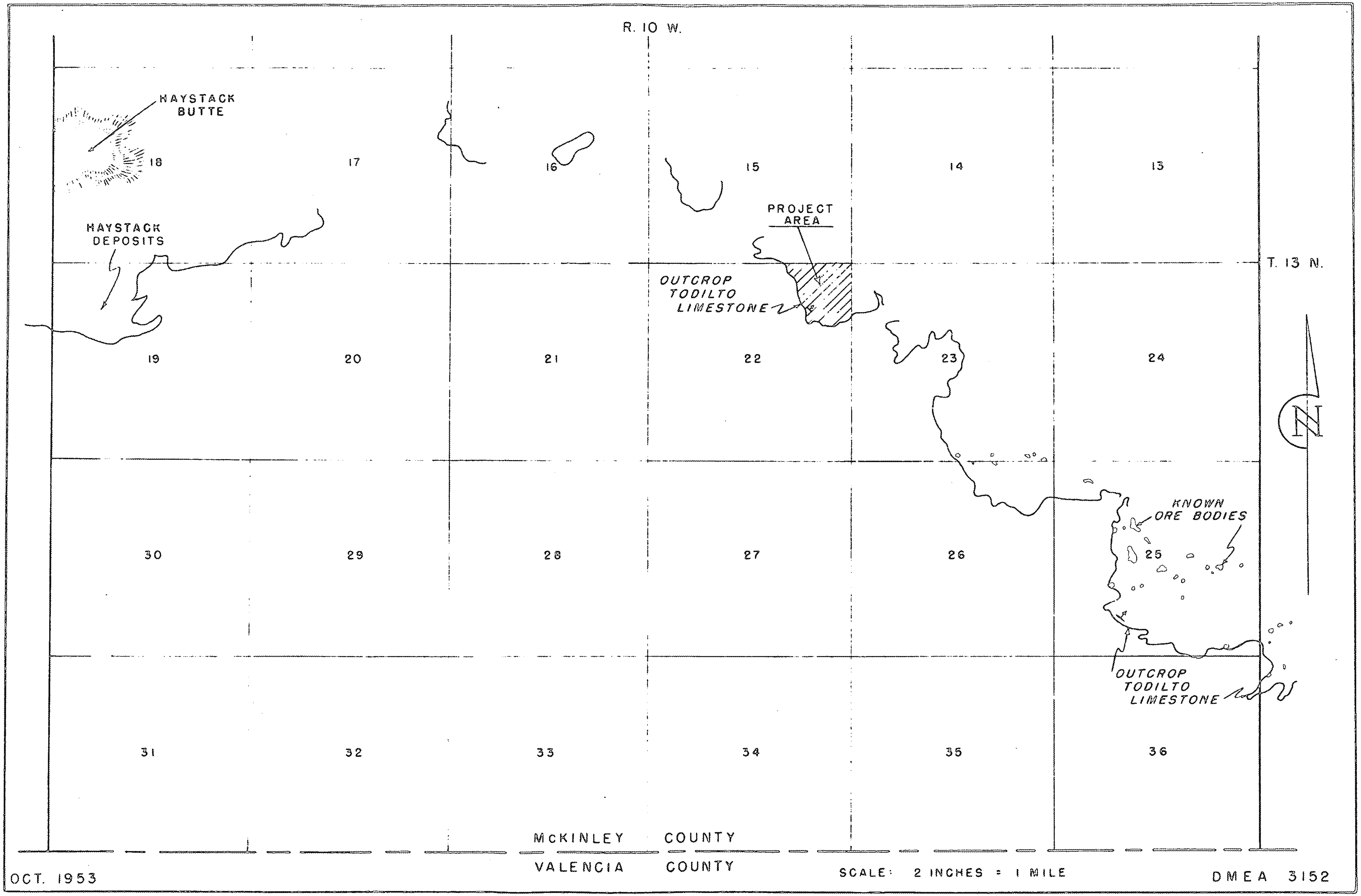

FIGURE 2. - OUTCROPS OF TODILTO LIMESTONE

HANOSH MINES, INC. (SHOWING SOME OF THE KNOWN ORE BODIES) McKINLEY COUNTY, NEW MEXICO

No drilling on 25-foot centers, as proposed by the applicant, is suggested, as it is believed that drilling on 100-foot centers with some 50-foot offsets will find most average sized deposits or at least suggest their proximity. Closer spaced drilling, however, probably would be required to obtain a reasonably accurate appraisal of the tonnage and grade of deposits and certainly would be required to develop them for mining. It is believed that the applicant should be willing to do at his own expense the work he considers necessary to develop ore for mining if the greater risks of exploration have already been taken in the DMEA project.

The applicant has proposed to take no samples from the holes drilled on 100- and 50-foot centers, but rather to rely upon radiometric determinations by in-hole logging equipment to select the holes to be offset. Although the AEC field personnel have recommended this practice, and it has been accepted by the DMEA examining team for use on projects already studied, a more critical analysis of the logging method shows that it has not been thoroughly tested and proved. Furthermore, the AEC does not have the capacity to do the radiometric logging on this project whereas they have promised to do it on other DMEA projects, and the applicant proposes instead to use unproved logging equipment. The examining team therefore recommends that, in addition to the proposed radiometric hole logging, samples of the drill cuttings representing 2-foot intervals throughout the Todilto limestone be taken from all drill holes. This sampling will of course increase the cost of the project, but it seems necessary for the present in order to ensure obtaining adequate guidance for the drilling and to establish the reliability of the logging equipment.

STANDARD FORM NO. 64

C

Office Memorandum • UNITED STATES GOVERNMENT

TO : E. Wm. Ellis, DMEA Member, Uranium Commodity Committee

DATE: March 29, 1954

FROM : Arthur P. Butler, Jr., USGS Member, Uranium Commodity Committee

SUBJECT: Final Field Team Report DMEA Docket 3225 (Uranium), Ira N. Sprecher, Gallup, New Mexico, trustee, applicant, Group Claims, Sec. 2, T. 13 N. R. 11 W.

The applicant applied for $4,000 to explore the property identified above for uranium. The property was examined and the application denied by Region IV. W. A. Carlson, Acting Chief of the Grants Sub-Office, U. S. Atomic Energy Commission, accompanied the examiners and agreed with their conclusion that Government participation was not warranted.

Parts of the property are underlain by three formations, the Todilto, Morrison, and Dakota that are host rocks for uranium ore in the general area surrounding the claims. Most of the applicant's exploration was planned to explore the Dakota formation. The examiners found that black shales in the Dakota are slightly uraniferous, but found nothing to suggest that uranium was likely to be sufficiently concentrated to form ore bodies. The Morrison rocks on the property do not have features commonly considered favorable to ore, and exploration by the AEC in an adjoining section suggests that the Todilto is not sufficiently favorable to warrant exploration at the depth that prevails on the property. For those reasons, the examiners recommended and the Field Team denied the application.

I concur with the Field Team's conclusion and action.

Arthur P. Butler, Jr.

Copies to: E. Wm. Ellis (2)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Mining Division
Region IV

March 10, 1954.

Memorandum

To: Field Team, Region IV

From: Chief, Mining Division, Region IV

Subject: Report of Examination - DMEA Docket 3225 (Uranium), Ira N. Sprecher, Group Claims, McKinley County, New Mexico.

Enclosed are eleven copies of the engineering report of examination on the subject docket.

The applicant requested $4,000.00 for a total of 4,600 feet of rotary drilling.

The engineer examiner concludes there is little chance that exploration would encounter significant uranium mineralization. The A.E.C. has drilled 40 holes immediately south of this property and no appreciable mineralization was found.

The engineer examiner recommends the application be denied and we concur in this recommendation.

W. H. King

W. H. King

Enclosures

Reviewed by
DMEA OPERATING COMMITTEE

3-19-54
(date)

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Docket

Ching
ellis

Project Summary Report

By: Michael Ching Date: August 6, 1957

1. Docket No. DMEA-3632 (Uranium)
   Contract No. Idm-E797

   Operator - Colamer Corporation, a Delaware corporation
   Commerce Building
   1016 West Santa Fe
   Grants, New Mexico

   Covers all sec. 8 except for a 1500' wide strip next to [illegible]

   Property - 27 unpatented mining claims, State Nos. 1-27, situated in sec. 8, T. 13 N., R. 9 W., N.M.P.M&B., McKinley County, New Mexico.

   Operator's Property Rights: Lessee. Owner's Consent to Lien signed by Thomas C. King and Phyllis J. King, Arthur W. Hyde and Vilatie W. Hyde, Lee Roy Cosper and Jane Hyde Cosper, J. V. Reynolds and Jean Reynolds, and Howard Deeds, a single man.

2. Contract (Short Form), dated May 17, 1955
   Final starting date, July 1, 1955
   Actual starting date, June 29, 1955
   Contract completion date, Sept. 15, 1956
   Termination Agreement, dated Jan. 22, 1957, effective July 20, 1956

   Work Authorized (as amended) - Test the Poison Canyon and Westwater Canyon sandstones of Jurassic age by core and non-core drilling in 3 stages as follows:

   Stage I - 78 holes

17,125 ft. non-core drilling @ $1.54/ft.	$26,372.50	
7,460 ft. core drilling @ $2.80/ft.	20,888.00	
20 chemical analyses @ $5/each	100.00	$47,360.50

   Stage II - 70 holes

15,750 ft. non-core drilling @ $1.54/ft.	$24,255.00	
4,900 ft. core drilling @ $2.80/ft.	13,720.00	
35 chemical analyses @ $5/each	175.00	$38,150.00

   Stage III - 60 holes

13,500 ft. non-core drilling @ $1.54/ft.	$20,790.00	
2,850 ft. core drilling @ $2.80/ft.	7,980.00	
30 chemical analyses @ $5/each	150.00	$28,920.00

Estimated Total Cost of the Project $114,430.50
Government Participation @ 75% $85,822.88

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DMEA
DEPARTMENT OF THE INTERIOR
DEC 3 1956
REGION III
DENVER, COLORADO

FINAL GEOLOGICAL ENGINERRING REPORT

ON

DMEA DOCKET 3632 CONTRACT Idm-E797

RECEIVED
DEC 7 1956
D.M.E.A.

8/8/68

Hold for written [illegible]
[illegible]

COLAMER CORPORATION

KELSEY L. BOL[illegible],
CHIEF GEOLOGIST.

MONTH	PLUG (FT)	CORE (FT)	COST PLUG	COST CORE	OST ASSAYS
Feb.	1,860	704	$2,864.40	$1,971.20	$15.00
March	6,279	1,652	9,669.66	4,625.60	
April	462	168	711.48	470.40	
July	1,321	226	744.80	2,034.34	
Totals			$43,242.64	$35,466.34	$315.00

Total DMEA -$79,023.98

Government Participation: 0.75 x $79,023.98 = $59,267.99

ORE RESERVES

Following are the results of calculations of ore reserves discovered under this contract. The contour method was used. (See Ore body Map)

	Tonnage	Grade
Indicated or inferred reserves	71,422	0.221% U_3O_8
Possible reserves	29,111	0.157% U_3O_8

COLAMER CORPORATION

KELSEY L. BOLTZ
CHIEF GEOLOGIST

UNITED STATES
DEPARTMENT OF THE INTERIOR
DOUGLAS McKAY, SECRETARY

DEFENSE MINERALS EXPLORATION ADMINISTRATION

REPORT OF EXAMINATION BY FIELD TEAM
REGION III

DMEA 3727, Santa Fe tracts

Santa Fe Uranium Company, Inc.

McKinley County, New Mexico

Uranium

Donald Haynes, Geologist
Geological Survey

Glen Walker, Mining Engineer
Bureau of Mines

August 1, 1955

Reviewed by
DMEA OPERATING COMMITTEE
9-9-55
(date)

Colorado Plateau District
P. O. Box 360
Grand Junction, Colorado

April 28, 1955

TRANSMITTED

AUG 29 1955

Memorandum

To: E. N. Harshman

From: T. E. Mullens

Subject: Preliminary report on DMEA 3727, Santa Fe Uranium Company, SW1/4 sec. 18, T. 13 N., R. 10 W., and N1/2 N1/2 sec. 13, T. 13 N., R. 11 W., McKinley County, New Mexico

The subject property was examined by a Region III examining team on April 26, 1955. The team consisted of Glen Walker, U. S. Bureau of Mines, and R. D. Haynes and T. E. Mullens, U. S. Geological Survey. The team was accompanied by Thomas Fife, Santa Fe Uranium Company engineer.

Briefly, the examining team will recommend some DMEA assistance to explore the SW1/4 sec. 18, but will not recommend DMEA assistance at this time to explore the N1/2 N1/2 sec. 13.

Santa Fe Uranium and the previous owners have done considerable work near some ore bodies in the central part of SW1/4 sec. 18. This work consists of a number of drill holes and an incline; however, none of the work was shown on the maps in the brochure with the exception of a "drill holes" notation. Without the location of the holes drilled and the incline, the examining team cannot plan an exploration program which would take advantage of previous work.

Mr. Fife told us that he had surveyed all holes on the property, but he has no map as he has not worked up his notes. Mr. Fife offered to send the Survey and the Bureau of Mines a copy of the map when he completes it. Then the examining team in connection with the company engineer could design a drilling program for the property.

As a matter of policy, I believe the map showing drill holes and incline should be included in the brochure. Thus, I recommend that DMEA write the applicant company and request 4 copies to go in the brochures. The maps should show the incline and drill holes. The drill holes should be divided into two classes: 1) drill holes which have been sampled and probed, and 2) drill holes which were not sampled or probed. The two classes are necessary as all records on some drill holes are lost and Santa Fe Uranium does not know what the holes penetrated. The map should also show the depth of the drill holes.

DMEA should also request that the company submit a drill hole map of the N1/2 N1/2 sec. 13. Nineteen AEC drill holes and several private drill holes have been drilled in this part of the section, and a map of these holes would complete the record. However, the examining team will not recommend any DMEA assistance for section 13 at this time.

T. E. Mullens

T. E. Mullens
Geologist

DMEA 3727

SANTA FE TRACTS
SANTA FE URANIUM COMPANY, INC.
McKINLEY COUNTY, NEW MEXICO

CONTENTS

Engineering report — Page

ILLUSTRATIONS

Figure — Follows page

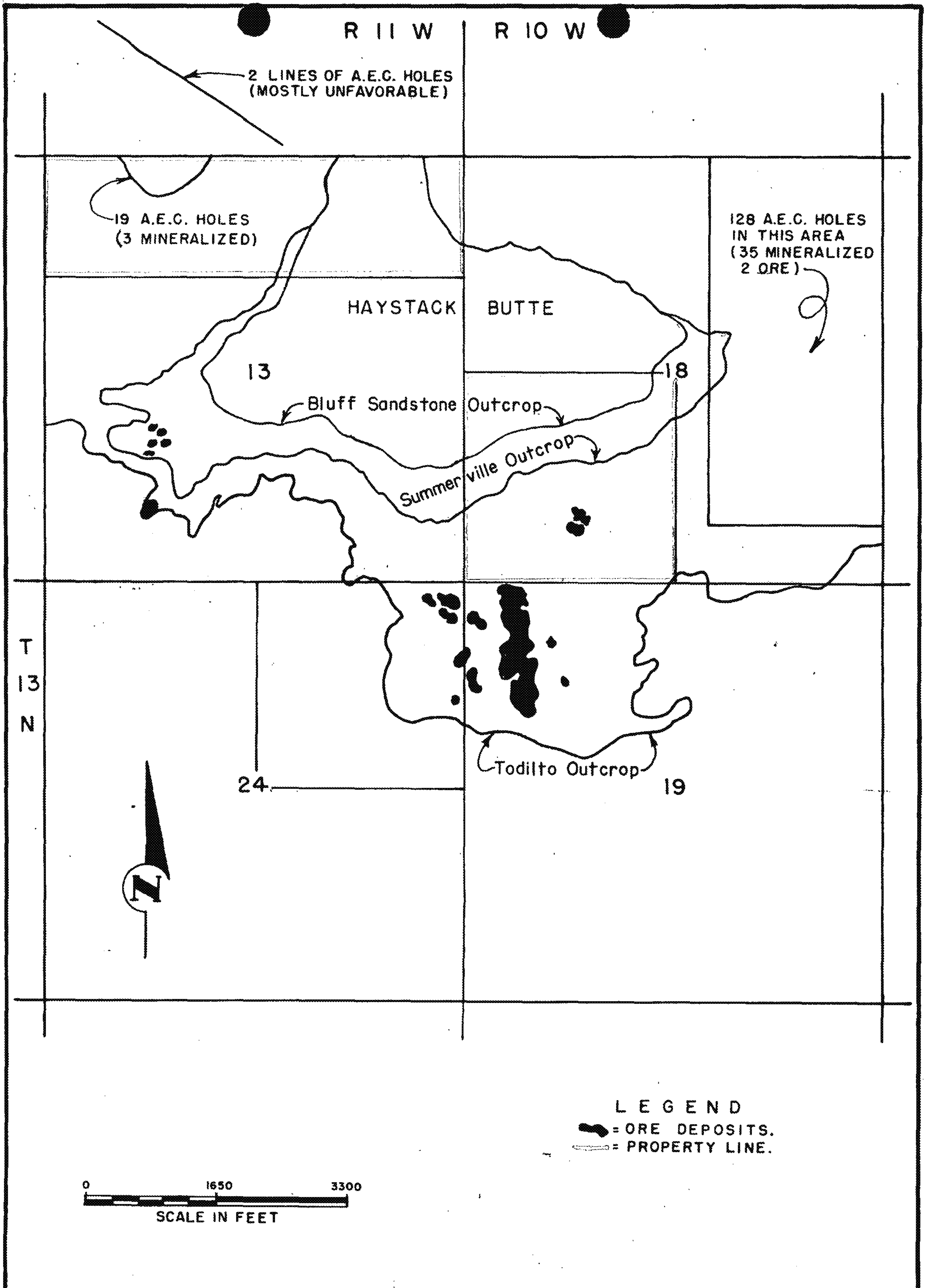


FIGURE 2-MAP SHOWING PROPERTY, OUTCROPS OF MAIN FORMATIONS, ORE DEPOSITS AND AREAS OF A.E.C. DRILLING, SANTA FE URANIUM CO., McKINLEY COUNTY, N.MEX. DMEA 3727

UNITED STATES ATOMIC ENERGY COMMISSION

RME-3050

FRACTURE PATTERN OF THE ZUNI UPLIFT

Final Report

By
Arthur K. Gilkey

June 1953

Columbia University
New York, New York

Technical Information Service, Oak Ridge, Tennessee

exhibit predominantly fracturing transverse to the fold axis while the second would show longitudinal fractures predominating. This criterion, or whatever other criteria would be found in its stead were to be applied to the Zuni uplift, as an approach toward understanding its origin. Then the other structural characteristics of the uplift were to be considered for any additional light they might provide.

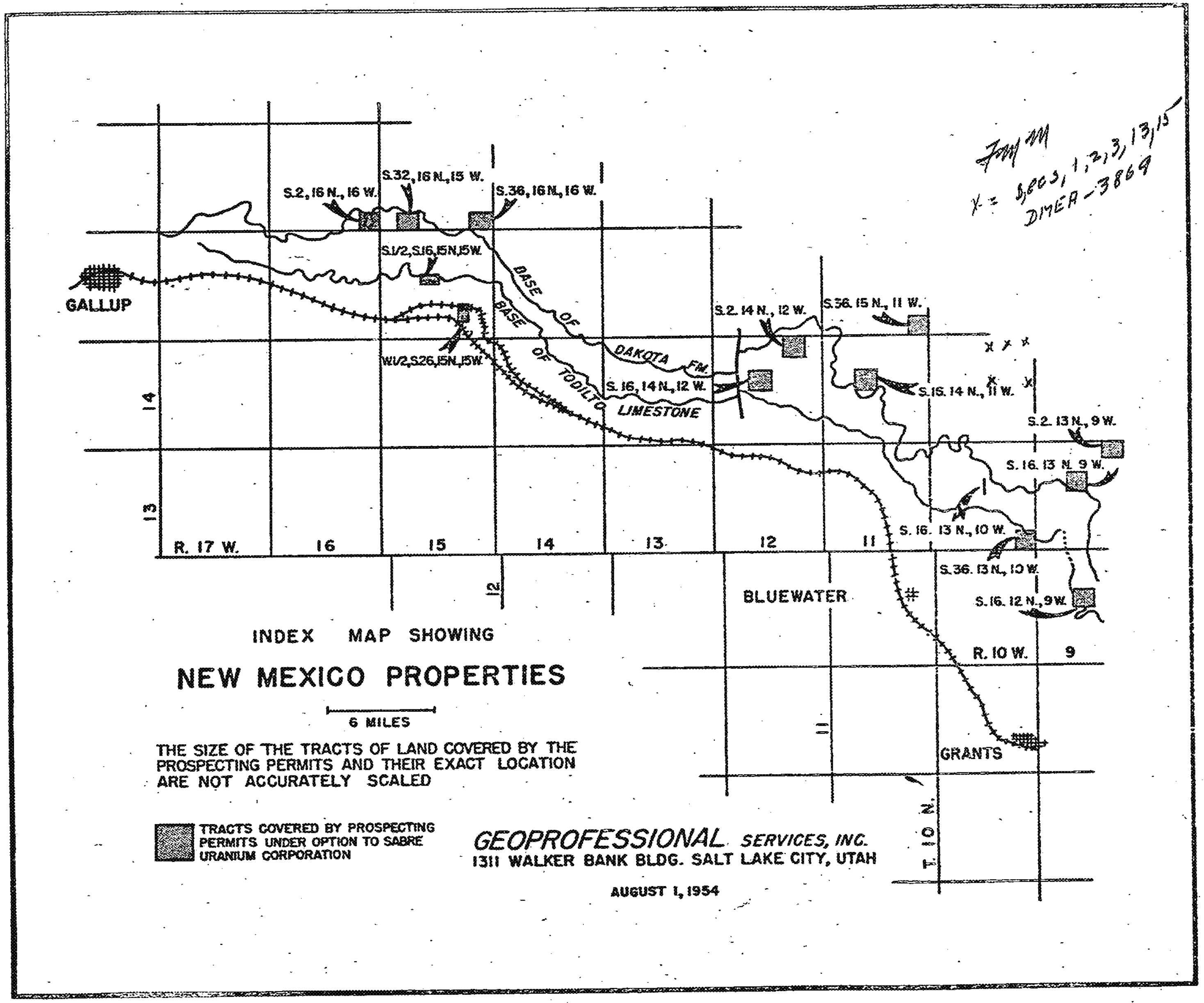
Specific Procedures and Data

The following structures were studied in the field as examples of smaller anticlines of known origin: for the laterally compressed type, one anticline in the Woods Hollow Mountains of the Marathon folded belt, west Texas, and a part of the Wills Mountain anticline in the folded Appalachians of northeastern West Virginia (a study done independently of this contract); and for the passively domed type, one laccolithic dome, Maze Arch, in the Henry Mountains of Utah. The data for these and for the Zuni uplift are presented on the attached maps, and the procedures and data will be described with reference to the individual maps.

Maps of the Zuni Uplift

Ground Samples of Jointing, Zuni Uplift, New Mexico:

This map gives the most general picture of the Zuni uplift. On it are included as many of the major faults as could be compiled from other sources, in addition to those which were observed in the field, in the course of the joint measurements. Faults in the pre-Cambrian are taken entirely from the map of that region made by E. N. Goddard, et al (1951), and faults of part of the northeast flank are from maps by the U.S. Atomic Energy Commission geologists, Grants, New Mexico. Geological contacts, shown only where they could be confidently identified, were transferred by pantograph from controlled serial mosaics. Beyond these features, the map represents essentially a plot of the joint data. It cannot be regarded as a complete indication of the jointing which will be found in any given part of the



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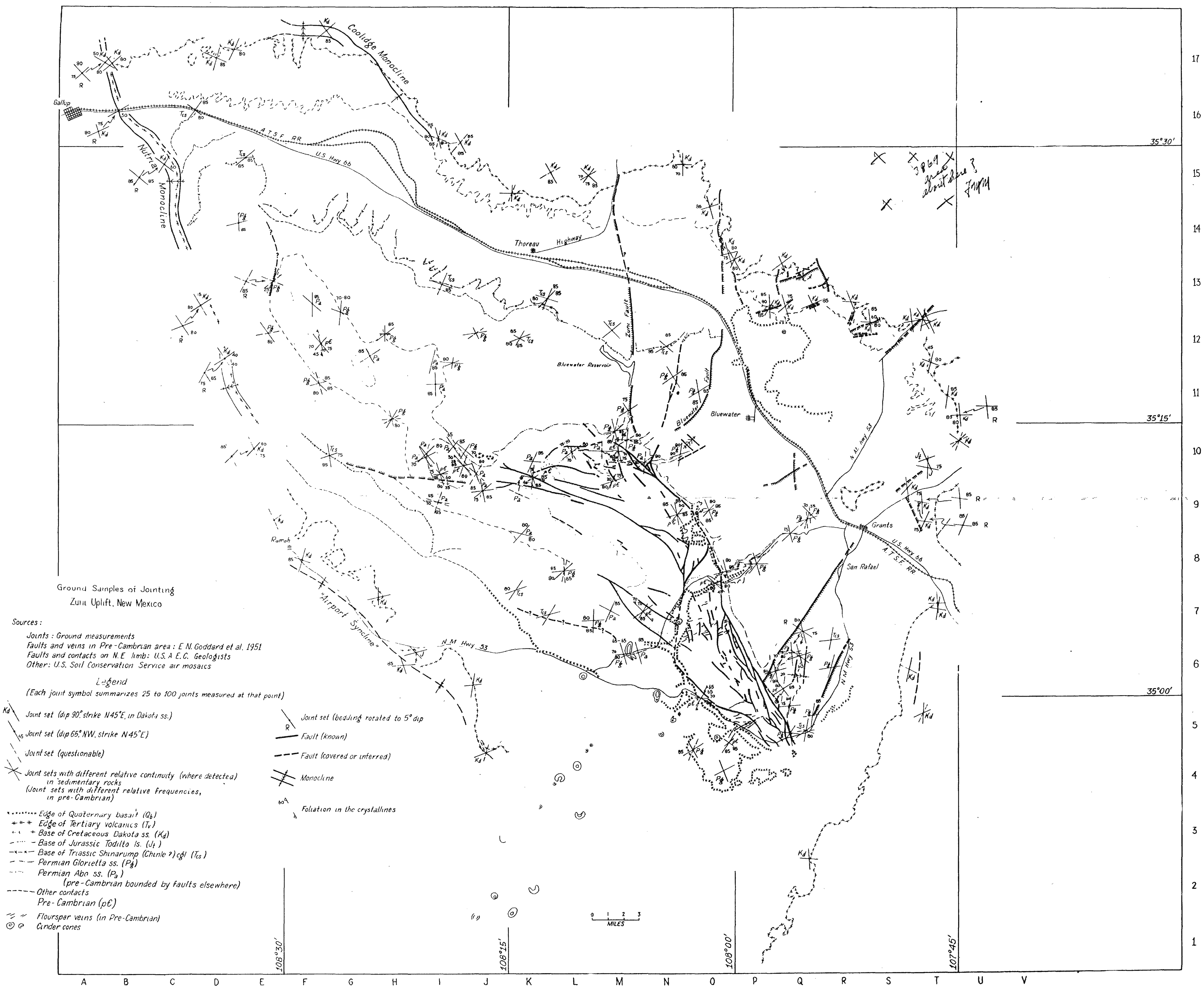
SABRE URANIUM CORP.
P. O. Box 1549
Grand Junction, Colo.


Ground Samples of Jointing
Zuni Uplift, New Mexico
Sources:
Joints: Ground measurements
Faults and veins in Pre-Cambrian area: E.N. Goddard et al. 1951
Faults and contacts on N.E. limb: U.S.A.E.C. Geologists
Other: U.S. Soil Conservation Service air mosaics
Legend
(Each joint symbol summarizes 25 to 100 joints measured at that point)
Joint set (dip 90°, strike N45°E, in Dakota ss.)
Joint set (dip 65° NW, strike N45°E)
Joint set (questionable)
Joint sets with different relative continuity (where detected) in sedimentary rocks
(Joint sets with different relative frequencies, in pre-Cambrian)
Edge of Quaternary basalt (Q_b)
Edge of Tertiary volcanics (T_v)
Base of Cretaceous Dakota ss. (K_d)
Base of Jurassic Todilto ls. (J_t)
Base of Triassic Shinarump (Chinle ?) cgl (T_{cs})
Permian Glorietta ss. (P_g)
Permian Abo ss. (P_a)
(pre-Cambrian bounded by faults elsewhere)
Other contacts
Pre-Cambrian (p€)
Flourspar veins (in Pre-Cambrian)
Cinder cones
Joint set (bedding rotated to 5° dip
Fault (known)
Fault (covered or inferred)
Monocline
Foliation in the crystallines
Gallup
Coolidge Monocline
Nutria Monocline
A.T.S.F. RR
U.S. Hwy 66
Thoreau
Highway
Zuni Fault
Bluewater Reservoir
Bluewater Fault
Bluewater
N.M. Hwy 53
Grants
San Rafael
Ramah
"Airport Syncline"
MILES
35°30'
35°15'
35°00'
108°30'
108°15'
108°00'
107°45'
A B C D E F G H I J K L M N O P Q R S T U V
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
224 New Customhouse
Denver 2, Colorado

OFFICIAL FILE COPY
DMEA
RECEIVED AUG 2 1957

DATE	INITIALS	CODE
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"	JEJ	110
		130
		220
8/6	Ching	170

July 30, 1957

Memorandum

To: Chairman, Operating Committee, DMEA

From: DMEA Field Team, Region III

Subject: Docket No. DMEA 3939 (Uranium), Contract No. ~~Idm-E934~~, ~~Food~~ Machinery and Chemical Corporation, Westvaco Mineral Products Division (Sec. 7, T 13 N, R 9 W), McKinley County, New Mexico - FINAL REPORT

Enclosed are the original and two copies of a joint final engineering and geologic report, dated July 1957, by H. F. Albee, Geologist, Geological Survey, and W. D. McMillan, Mining Engineer, Bureau of Mines; and transmittal thereof, dated July 26, 1957, from J. William Hasler.

The original and one copy of the Operator's final report were forwarded by memorandum of January 17, 1957.

The contract was terminated before completion of all the work provided for, by a TERMINATION AGREEMENT, dated January 9, 1957, which was made effective as of the close of business October 31, 1956.

The exploration work completed under the contract consisted of the drilling of 22 holes, aggregating 4,317 feet of non-core drilling and 1,157 feet of core drilling, and incidental allowance on a total of 5,474 feet of drilling,at a total accepted cost of $10,091.41, toward which the Government contributed 75%, or an amount of $7,568.56.

Final payment to the Operator was processed by this office March 5, 1957 in conformance with the Report of Review of reported project costs by the Contract Administration and Audit Division, DMEA, dated February 20, 1957.

The exploration work completed did not result in the discovery or development of a significant quantity of uranium ore; therefore, Certification of such under the provisions of the contract is not recommended.

E. N. Harshman

E. N. Harshman
Acting Executive Officer

Reviewed by
DMEA OPERATING COMMITTEE
8-5-57
(date)

FINAL F.T. REPORT

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DATE	INITIALS	CODE
		~~130~~
		220

UNITED STATES
DEPARTMENT OF THE INTERIOR
FRED A. SEATON, SECRETARY

DEFENSE MINERALS EXPLORATION ADMINISTRATION

JOINT FINAL REPORT OF EXAMINATION BY EXAMINING TEAM
REGION III

DMEA 3939 CONTRACT Idm-E 934

FOOD MACHINERY AND CHEMICAL CORPORATION

Westvaco Mineral Products Division

Section 7, T. 13 N., R. 9 W., N.M.P.M.

McKinley County, New Mexico

Uranium

Joint Final Engineering and Geologic Report

by

H. F. Albee
Geological Survey

W. D. McMillan
Bureau of Mines

July 1957

Reviewed by
DMEA OPERATING COMMITTEE
8-5-57
(date)

1. In the vicinity of ore deposits the ore-bearing sandstones are 50 feet or more thick.

2. The ore-bearing sandstones are altered from a yellow brown or orange to a light gray color near ore deposits.

3. Mudstone in contact with ore-bearing sandstones is green or greenish gray near ore deposits instead of red or reddish brown.

4. Carbonaceous material, asphaltite, limonite, and claystone pebbles and seams are more abundant in the vicinity of ore deposits.

DMEA drilling disclosed an ore body in the northwest corner of sec. 8 in the Poison Canyon sandstone east of the Morrison formation by the Colamer Corporation on the State group of claims in sec. 8, T. 13 N., R. 9 W., N.M.P.M., DMEA docket 3632, contract Idm-E 797 (fig. 2).

The most pronounced standard feature on sec. 8 is a north-trending normal fault zone lying in the west half of the section. Considerable minor folding has occurred on sec. 8 and shows that small anticlines coincide with the axes of the thick sandstone zones thus suggesting that these small folds are a result of differential compaction rather than of original process. The ore deposit contains an estimated reserve of about 80,000 tons of uranium ore that will average 0.22 percent U_3O_8 and 8 feet in thickness. The ore deposit appears to be about 1,000 feet long and averages about 150 feet wide with the long axis trending southeasterly. The depth to the ore body, from the surface, will be about 250 feet.

Section 10, T. 13 N., R. 9 W., N.M.P.M. was explored by DMEA under DMEA docket No. 4017, contract Idm-E 940, Colamer Corporation. Both the Poison Canyon sandstone unit and the Westwater Canyon member of the Morrison formation were tested in the Phyllis, Fannie, Jean, and Deetta claim groups in the same section with essentially negative results. This contract was completed and terminated without a certification of discovery.

WORK COMPLETED UNDER THE CONTRACT

Contract Idm-E934 was executed on March 21, 1956 and the project was started on April 16, 1956, with drilling beginning on June 20, 1956 and completed on October 23, 1956.

Stage I consisted of 15 non-core and core drill holes and Stage II consisted of 7 non-core and core drill holes. Total drilling under the contract was 4,317 feet of non-core and 1,157 feet of core in 22 holes. Details presented in Table No. I and hole locations are shown in Figure 2.

UNITED STATES
DEPARTMENT OF THE INTERIOR
Defense Minerals Exploration Administration
224 New Customhouse
Denver 2, Colorado

April 8, 1958

Memorandum

To: All DMEA Engineers, Region III

From: DMEA Field Team, Region III

Subject: Semiannual Reports: "Investment Data" Heading

Quoted below is part of a letter from the Chairman, Operating Committee, DMEA, concerning a Semiannual Report of a project whose Operator is investing additional capital as a result of DMEA ore findings. The Chairman's comments refer specifically to the heading "Investment Data" on page 2 of the report.

> "The report gives a general picture of the underground workings completed and of equipment on hand, but, aside from the shaft, no investment costs are given.
>
> "In such cases as this we would like to have the approximate cost of development openings to date, of the steel headframe, and of the equipment on hand. We would be interested in knowing whether or not the Operator would object to supplying such information, and whether the examiners have been making direct requests for such data. Of course, the Operator should be assured that such information is to be used by the Government for general statistical purposes only.
>
> "Investment data should be presented in such a manner that it can be carried forward from period to period. Figures on the reporting form should be cumulative."

The comments should be considered when preparing Semiannual Reports in the future. We suggest that you review the Semiannual Report file of projects which are inspected by you and bring the Investment Data to date preparatory to the next inspection. Should your next inspection show that the Operator is investing additional capital in the project (directly or indirectly) as a result of DMEA work, please state under the heading "Remarks" on page 2 of the report the response of the Operator to your request for Investment Data.

Discovery of ore reserves resulting from DMEA work in many instances has lead to future exploration and development. The full report of additional investment data, therefore, will tend to establish the true effectiveness of the DMEA program.

MHM:jy
cc: DMEA,DFC - 10
DMEA,SLC - 4
DMEA,G.Jct. - 4
DMEA,TUC - 4

E. N. Harshman
E. N. Harshman

JW Townsend
J. W. Townsend
Acting Member

Hmc

RECEIVED
OCT 29 1956

Treasure URANIUM AND RESOURCES, INC.

531 SOUTH STATE STREET — SALT LAKE CITY 11, UTAH

DMEA
DEPARTMENT OF THE INTERIOR
OCT 24 1956
REGION III
DENVER, COLORADO

October 22, 1956

Mr. W. M. Traver, Exec. Officer
DMEA Field Team, Region III
U.S. Dept. of the Interior
224 New Customhouse
Denver 2, Colorado

Re: Docket DMEA 4411 (uranium)

Dear Mr. Traver:

In response to your request, we are enclosing three competitive bids for the proposed drilling of the NW ¼ Sec. 6, T.13 N., R.9 W., NMPM, New Mexico. It appears from the current bids in this area that we could revise our estimated non-core drilling costs downward from $1.50 per foot to $1.25 per foot. This figure, of course, includes the cost of circulation materials, drilling water, sample bags, and core boxes. We do not feel that the rate for core-drilling can be similarly adjusted.

We would like also at this time to advise you that we have received correspondence from the Bureau of Indian Affairs approving the transfer of the Uranium Mining Lease on the above land from New Park Mining Co. to Treasure Uranium & Resources, Inc. . We can furnish the Defense Minerals Exploration Administration a copy of this approval when it is desired.

Sincerely,

L. H. Baumgardner

L. H. Baumgardner, Geologist

ED_006270_00000674-00204

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

December 9, 1957
Re: DMEA 4411 Idm-E1052
Treasure Uran. & Resources, Inc.
NW 1/4 Sec. 6, T13.N, R9W, NMPM
McKinley County, New Mexico
Uranium

Memorandum

To: E. W. Ellis, Defense Minerals Exploration Administration

From: N. E. Nelson, U. S. Geological Survey

Subject: Review of Field Team Final Report

The contract, awarded Jan. 17, 1957, approved the expenditure of $25,832.00 on the exploration by drilling of a quarter section of land underlain by Morrison formation. More particularly the exploration was concerned with rocks of the Brushy Basin and Westwater Canyon members of the Morrison formation as large uranium deposits occur in the Brushy Basin member in the area to the south (Grants) and to the north in the Ambrosia Lake area in the Westwater Canyon member.

As interpreted by the examiners, the referenced quarter section lies within a transitional zone in which, as determined by a large amount of drilling, much of it DMEA assisted, no large deposits of uranium minerals occur.

The property had been explored by 5 widely spaced drill holes. Gamma-ray logs showed mineralized material, as did 7 of the project holes. Two of 8 Stage I holes, D-6.5 and J-11, showed values in excess of 0.05, (0.051 and 0.055) U_3O_8 and one of 23 Stage II holes, C-13.5, showed 2 feet of 0.06% U_3O_8. Expenditures amounted to $18,444.84.

In the opinion of the examiners further work is not warranted and they recommend that the project be terminated without certification of discovery.

I concur with the opinion and the recommendation.

N. E. Nelson
N. E. Nelson

DMEA 4411
Contract Idm-E 1052

TREASURE URANIUM AND RESOURCES, INC.
SEC. 6, T. 13 N., R. 9 W., NMPM
McKINLEY COUNTY, NEW MEXICO

INTRODUCTION AND SUMMARY

Treasure Uranium and Resources, Inc., applied to Defense Minerals Exploration Administration for assistance in exploring for uranium ore on lots 3, 4, and the SE¼ NW¼, Sec. 6, T. 13 N., R. 9 W., NMPM, McKinley County, New Mexico. The applicant proposed to explore the underlying Morrison formation of Jurassic age by 17,000 feet of core and non-core drilling in 34 holes having an average depth of 500 feet, at an estimated cost of $34,500.00.

An inspection of the property was made on September 18, 1956, by a Region III DMEA examining team, consisting of Edward W. Buel, U. S. Bureau of Mines, and Howard F. Albee, U. S. Geological Survey, accompanied by Luke Baumgardner, geologist for the applicant.

The property had been partially explored by five widely spaced drill holes with mineralized material present in all holes as indicated by gamma-ray logs made by the U. S. Atomic Energy Commission. No chemical assay data were available and the examining team was unable to evaluate geological features of the ore-producing formations because of overburden. The geology and conclusions were based on previous DMEA contracts and private drilling in nearby areas which indicated that the property might contain no significant uranium deposits. Thirty-one DMEA holes were drilled on the property; of these eight were weakly mineralized, but none showed ore-grade material.

ORE RESERVES

No uranium deposits were discovered by the DMEA project; consequently there are no ore reserves to be calculated, and therefore no certification of discovery will be recommended.

WORK COMPLETED UNDER CONTRACT

Contract No. Idm-E 1052 was executed on January 17, 1957. Work was started on March 2, 1957, and was completed on June 8, 1957. Stage I consisted of 2,016 feet of non-core drilling and 1,370.75 feet of core drilling, a total of 3,386.75 feet. Stage II consisted of 9,694 feet of non-core drilling.

Details of the drilling by stages are given in table no. 2, and the locations of the drill holes are shown in figure 4.

FINAL DRILLING REPORT

NW¼ SEC. 6, T13N, R9W, NMPM, McKINLEY COUNTY, NEW MEXICO

DMEA CONTRACT Idm-E1052, DOCKET 4411 (URANIUM)

TREASURE URANIUM & RESOURSES INCORPORATED, SALT LAKE CITY, UTAH

During March, May and June, 1957, a total of 31 exploratory holes were drilled on the NW¼ Section 6, T13N, R9W, NMPM, McKinley County, New Mexico.

These holes were drilled under the provisions of a joint contract with the Defense Minerals Exploration Administration and Treasure Uranium & Resourses Incorporated, 531 South State Street, Salt Lake City 11, Utah. This contract, Idm-E1052, Docket 4411, provided that the DMEA would participate and be responsible for 75% of the authorized costs of the drilling project.

All holes were collared in the thin mantle of Recent alluvium that immediately overlies the Mancos formation and were bottomed in the upper five feet of the Recapture member of the Morrison formation. The Westwater Canyon member of the Morrison formation and a possible tongue of the Westwater that extends into the overlying Brushy Basin member (locally called Poison Canyon) were the drilling targets.

The drilling project was divided into two stages; the first consisted of eight drill holes that were plug-drilled to the approximate middle of the Brushy Basin member and cored from that horizon through the complete underlying Westwater Canyon member into the upper five feet of the Recapture member; the second stage consisted of twenty three holes that were plug-drilled the entire way to the Recapture member, with two-foot samples collected from the same intervals that the first eight holes were cored. All core and cuttings were properly labeled and stored with Four Corners Exploration Company a few miles west of Grants, New Mexico.

The following is a summary of all of the authorized operations and their costs incurred during the operation of the entire project.

OPERATION	UNIT	TOTAL UNITS	TOTAL COSTS	UNIT COST
Core Drilling	ft.	1370.75	4112.25	3.00
Plug Drilling	ft.	11710.00	9836.40	.84
Standby time	hr.	10.5	126.00	12.00
Chem. analyses	ea.	18	90.00	5.00
Core boxes	ea.	112	140.00	1.25
Incidental Allow	ft.	(Stage 1) 3386.75	2201.39	.65
"	"	(Stage 2) 9694.00	1938.80	.20
		Total Project Cost	18444.84	

E-104A
(April 1952)

Budget Bureau No. 42-R1151.2

UNITED STATES
DEPARTMENT OF THE INTERIOR

SAMPLE

DEFENSE MINERALS EXPLORATION ADMINISTRATION

SAMPLE

OPERATOR'S UNIT COST AND PROGRESS REPORT

Month of .... 195... Docket No. DMEA 4411 Contract No. Idm-E1052

Operator's Name Treasure Uranium and Resources, Inc. Minerals Uranium

Address Salt Lake City 11, Utah

Operation	Unit	Costs This Month	Units This Month	Costs to Date	Units to Date	Unit Costs to Date	Authorized by Contract: Units	Authorized by Contract: Unit Costs
			STAGE I					
xxxxxxNon-core drill	ft.			1693.44	2016	0.84	2040	1.00
xxxxxxxxCore drill.	ft.			4112.25	1370.75	3.00	1510	4.00
xxxxxx Bulldozing	hr.			0.00	0	0.00	16	12.00
xxxxx Standby time	hr.			42.00	3.5	12.00	8	12.00
xxxxx Incid. Allow.	ft.			2201.39	3386.75	0.65	3550	0.65
xxxxxxxxxx Core Boxes	ea.			140.00	112	1.25	150	1.25
xxxxxAnalyses	Spl.			25.00	5	5.00	16	5.00
Auger			STAGE II					
xxxxxxxNon-core drill	ft.	(Complete for		8142.96	9694	0.84	11,540	1.00
xxxxxxx Bulldozing	hr.	current month		0.00	0	0.00	40	12.00
xxxxxxxStandby time	hr.	and adjust Units		84.00	7	12.00	26	12.00
xxxxxxxxxxxIncid.Allow.	ft.	and costs to		1938.80	9694	0.20	11,540	0.20
Analyses	Spl.	date.)		65.00	13	5.00	50	5.00
TOTAL DISTRIBUTED COSTS				18444.84				TOTAL COSTS AUTHORIZED BY CONTRACT
Operating Equipment Purchased								
Initial Rehabilitation and Repairs								
New Buildings, Improvements, etc.								
TOTAL COSTS				18444.84				

The undersigned company, and the official executing this certification on its behalf, hereby certify that the information contained in this report is correct and complete to the best of their knowledge and belief.

Date .... Operator ....

Per .... Title ....

REMARKS: ....

→ **NOTE.—Title 18, U. S. Code (Crimes), section 1001, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.**

(Instructions on reverse)

(For Government use only)

RECEIVED JUL .. 1957 D.M.E.A.

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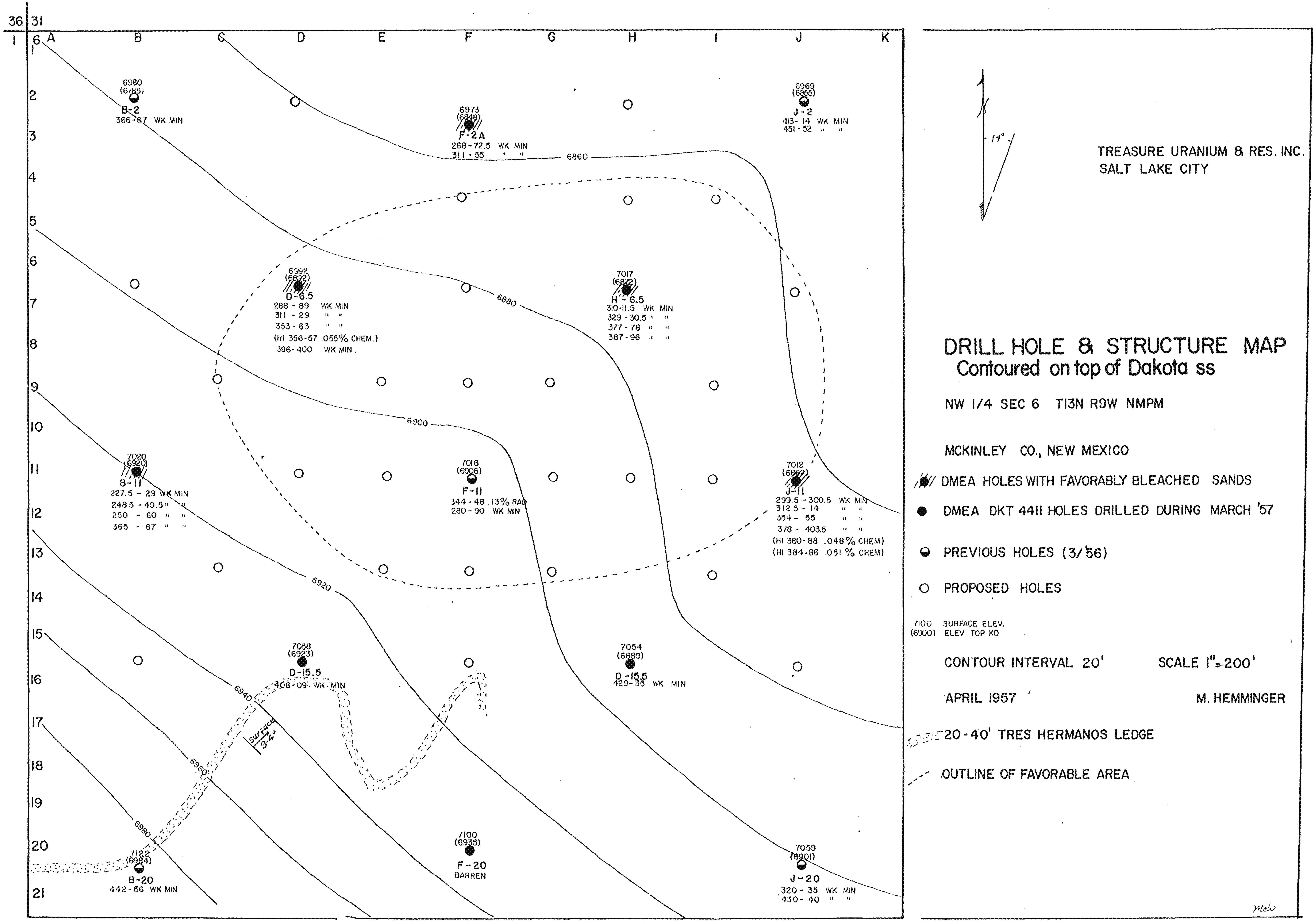

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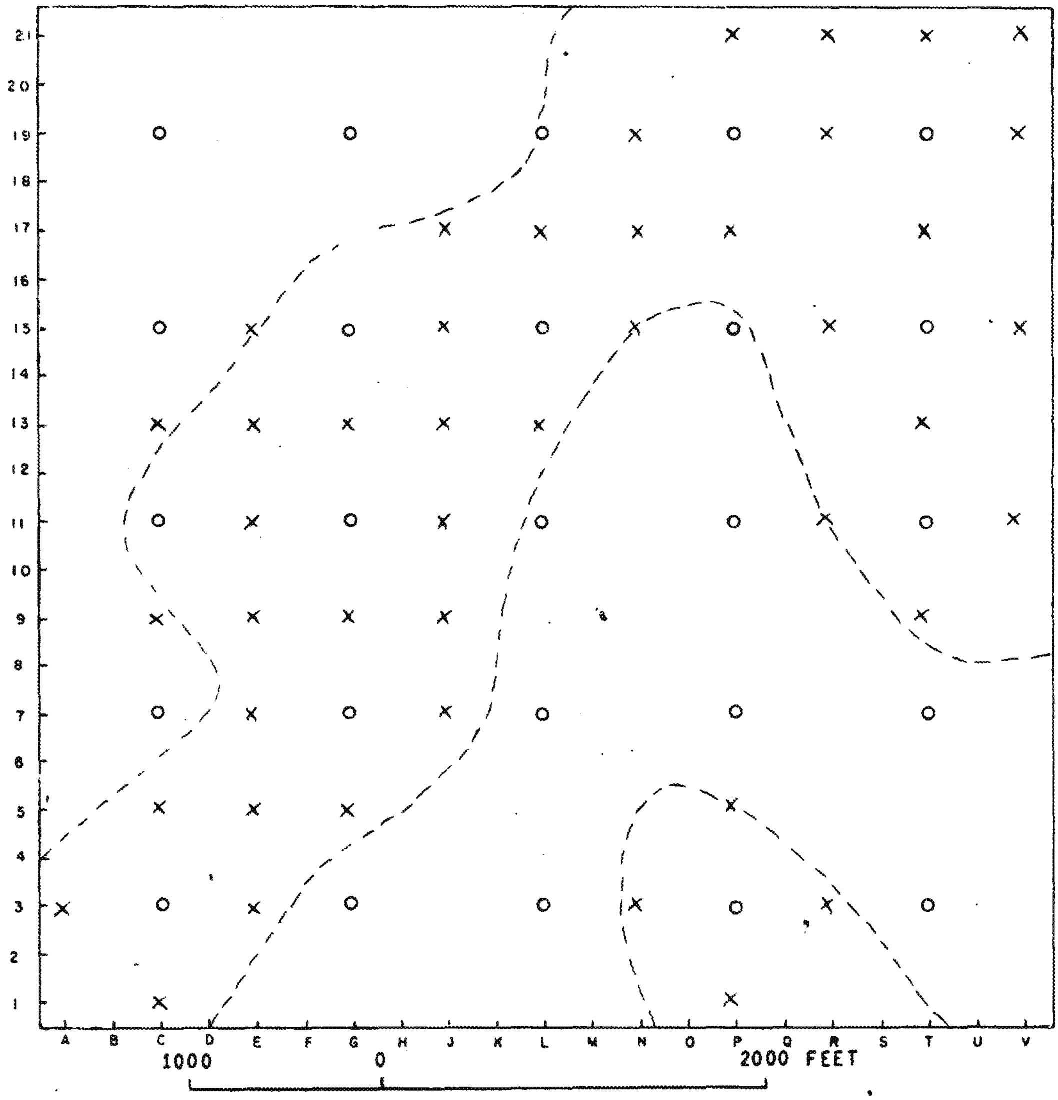
U.S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DEFENSE MINERALS EXPLORATION ADMINISTRATION
MARCH 1957
DOCKET 4590



EXPLANATION

100 cps ISORAD LINE

DRILL HOLES

○ DRILLED BY COMPANY

× PROPOSED STAGE I DRILL HOLE

FIGURE 3.—MAP OF SECTION 34, T.14N., R.10W., N.M.P.M., SHOWING LOCATION OF PROPOSED STAGE I DRILL HOLES, NEW JERSEY ZINC COMPANY, MCKINLEY COUNTY, NEW MEXICO.

SAN MATEO CREEK BASIN LEGACY URANIUM MINES SUPERFUND SITE
ENCLOSURE 2

TABLE: MINES WITHIN THE SITE BOUNDARY

Company	Mine	Location (Study Area)
United Nuclear Corporation	Ann Lee, Cliffside, Dysart No. 1, Dysart No. 2, Isabella, John Bully, Mary No. 1, Sandstone, Section 10, Section 12, Section 13, Section 15, Section 23, Section 25, Section 27, Section 29, Section 32, Section 33	Ambrosia Lake
	Faith, Flea, Isabella South	Poison Canyon
	Hogan, Marquez, San Mateo	Upper San Mateo Creek
ConocoPhillips Company	Ann Lee, Cliffside, Isabella, John Bully, Sandstone, Section 24, Section 29, Section 33	Ambrosia Lake
	Section 13, Faith, Isabella South	Poison Canyon
	Doris	Lower San Mateo Creek
	Chill Willis	Upper San Mateo Creek
Hecla Mining Company	Isabella	Ambrosia Lake
	Hope, Isabella South, Section 36	Poison Canyon
	Johnny M	Upper San Mateo Creek
	Doris	Lower San Mateo Creek
Homestake Mining Company	Ann Lee, Dysart No. 1, Dysart No. 2, Mary No. 1, Section 10, Section 13, Section 15, Section 23, Section 25, Section 27, Section 30, Section 32	Ambrosia Lake
	Flea	Poison Canyon
	Hogan, San Mateo	Upper San Mateo Creek
Layne Christensen Company	Dysart No. 2, Isabella, Mary No. 1	Ambrosia Lake
Rio Algom	Section 10, Section 17, Section 19, Section 22, Section 24, Section 30, Section 30 West, Section 33, Section 35	Ambrosia Lake
	Section 23, Section 25,	Poison Canyon
	Marquez	Upper San Mateo Creek
Chevron Corporation	Mt. Taylor	Upper San Mateo Creek
Rio Grande Resources (El Paso Natural Gas)	Mt. Taylor, San Mateo	Upper San Mateo Creek
Holly Minerals Corporation	Bucky	Ambrosia Lake
Cobb Resources Corporation	Bucky, Dysart No. 2, Section 10, Section 12	Ambrosia Lake
	Section 32, Section 33	Tronox

SAN MATEO CREEK BASIN LEGACY URANIUM MINES SUPERFUND SITE
ENCLOSURE 3

FEDERAL NOTICE LETTER RECIPIENTS

Department of Energy (DOE):
Steven Croley
General Counsel
Forrestal Building, Room 6A245 (GC-1)
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Department of the Interior (DOI):
Daniel H. Jorjani
Solicitor
1849 C Street, N.W.
Washington, D.C. 20240

PRIVATE PARTY NOTICE LETTER RECIPIENTS

ConocoPhillips Company
Gary Shiu, Attorney
ConocoPhillips Company
925 North Eldridge Parkway
Houston, Texas 77079

Layne Christensen Company
Layne Christensen Company
1800 Hughes Landing Boulevard, Ste. 800
The Woodlands, Texas 77380

Chevron USA, Inc.
Michelle Bacon, Attorney
Chevron USA, Inc.
6001 Bollinger Canyon Road
San Ramon, California 94583

Homestake Mining Company
Patrick Malone, Attorney
Homestake Mining Company
310 Main Street, Suite 1150
Salt Lake City, Utah 84101

Rio Grande Resources
Rio Grande Resources Corporation
P.O. Box 1150
Grants, New Mexico 87020

Holly Minerals
Holly Minerals
2828 N. Harwood, Suite 1300
Dallas, Texas 75201

Cobb Resources
George Lotspeich
Cobb Resources
4011 Mesa Verde NE,
Albuquerque, New Mexico 87110

Hecla Limited
Paul Glader
Hecla Limited
6500 N. Mineral Drive, Suite 200
Coeur de'Alene, Idaho 83815-9408

United Nuclear Corporation
Monique Mooney, Attorney
United Nuclear Corporation
412 Creamery Way, Suite 100
Exton, Pennsylvania 19341

Rio Algom Mining, LLC
Tom Appleman, Attorney
Rio Algom Mining, LLC
1500 Post Oak Blvd.
Houston, Texas 77056

FILED
United States Court of Appeals
Tenth Circuit

July 19, 2017

Elisabeth A. Shumaker
Clerk of Court

PUBLISH

UNITED STATES COURT OF APPEALS

TENTH CIRCUIT

CHEVRON MINING INC.,

Plaintiff - Appellant,

v.

UNITED STATES OF AMERICA, UNITED STATES DEPARTMENT OF THE INTERIOR, and UNITED STATES DEPARTMENT OF AGRICULTURE,

Defendants - Appellees.

AMERICAN EXPLORATION & MINING ASSOCIATION, COLORADO MINING ASSOCIATION, and STATE OF MONTANA,

Amici Curiae.

No. 15-2209

APPEAL FROM THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF NEW MEXICO (D.C. NO. 1:13-CV-00328-MCA-KK)

Peter D. Keisler, Sidley Austin LLP (Jennifer G. Anderson, Alex C. Walker, and Jeremy K. Harrison, Modrall, Sperling, Roehl, Harris & Sisk, P.A., Albuquerque, New Mexico, R. Timothy McCrum, Kirsten L. Nathanson, and Sherrie A. Armstrong, Crowell & Moring LLP, Washington, D.C., and Quin M. Sorenson and Christopher A. Eiswerth, Sidley Austin LLP, Washington, D.C., with him on the briefs), Washington, D.C., for Appellant.

Katherine J. Barton, Environment & Natural Resources Division, United States Department of Justice (John C. Cruden, Assistant Attorney General, Simi Bhat, Justin D. Heminger, Dustin J. Maghamfar, John E. Sullivan, and Evelyn S. Ying, Environment & Natural Resources Division, United States Department of Justice, and of Counsel: Joan Marsan, Office of the Solicitor, United States Department of the Interior, and Kirk Minckler, Office of the General Counsel, United States Department of Agriculture, with her on the brief), Washington, D.C. for Appellees.

Gina Cannan and Steven J. Lechner, Mountain States Legal Foundation, Lakewood, Colorado, on the brief for Amici Curiae American Exploration & Mining Association and Colorado Mining Association.

Timothy C. Fox, Montana Attorney General, Alan Joscelyn, Chief Deputy Attorney General, and Dale Schowengerdt, Solicitor General, Office of the Montana Attorney General, Helena, Montana, on the brief for Amicus Curiae State of Montana.

Before **TYMKOVICH**, Chief Judge, **BALDOCK**, and **BRISCOE**, Circuit Judges.

TYMKOVICH, Chief Judge.

Under the federal environmental laws, the owner of property contaminated with hazardous substances or a person who arranges for the disposal of hazardous substances may be strictly liable for subsequent clean-up costs. In this case, the United States owned national forest lands in New Mexico that were mined over several generations by Chevron Mining Inc. The question we must resolve is whether the United States is a "potentially responsible party" (PRP), *see, e.g.*, 42 U.S.C. § 9620(e)(6), for the environmental contamination located on that land.

We conclude that under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 U.S.C. §§ 9601–75, the United States is an "owner," and, therefore, a PRP, because it is strictly liable for its equitable portion of the costs necessary to remediate the contamination arising from mining activity on federal land. We also conclude in this case that the United States cannot be held liable as an "arranger" of hazardous substance disposal because it did not own or possess the substances in question.

Exercising jurisdiction pursuant to 28 U.S.C. § 1291, we therefore reverse the district court in part and affirm in part, and remand for further proceedings to determine the United States's equitable share, if any,[1] of the clean-up costs.

I. Background

Over the last century, Chevron and its corporate predecessors mined molybdenum at a site near Questa, New Mexico, which we and the parties refer to as the "Questa Site." This extensive mining generated significant amounts of hazardous substances, ultimately triggering costly clean-up requirements. Both before and after the Environmental Protection Agency (EPA)'s 2011 decision to place the Questa Site on the National Priorities List (NPL), *see* 42 U.S.C. § 9605(a)(8), Chevron acknowledged its status as a PRP strictly liable for the

---

[1] Because we remand to the district court to address equitable allocation, *see* 42 U.S.C. § 9613(f)(1), we take no position on whether a party's status as a PRP precludes a determination that its equitable share of response costs is zero.

hazardous substances contaminating the site. Chevron began remediation measures[2] pursuant to three administrative orders between it and the EPA. These measures are ongoing and projected to continue for decades to come, with anticipated costs exceeding $1 billion. Seeking financial contributions for the clean-up, Chevron filed suit against the United States asking for a declaration that the government is also strictly liable as a PRP—both as an "owner" of portions of the Questa Site and as an "arranger" of hazardous substance disposal, *see* 42 U.S.C. § 9607(a)—for its equitable share of past, present, and future clean-up costs. *See* 42 U.S.C. § 9613(f)(3)(B).[3]

The particular mining and disposal activities relevant to this appeal are summarized below.

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[2] Whether and what types of costs are necessary and consistent with the National Contingency Plan (NCP), *see* 42 U.S.C. § 9605, and the distinctions between costs incurred as part of "removal actions" and "remedial action[s]," 42 U.S.C. § 9601(23)–(24), is not relevant for purposes of this appeal. We refer generally to all such clean-up costs incurred or that will be incurred.

[3] "A person who has resolved its liability to the United States or a [s]tate for some or all of a response action or for some or all of the costs of such action in an administrative or judicially approved settlement may seek contribution from any person who is not party to a settlement . . . ." *Id.*; *see Cooper Indus., Inc. v. Aviall Servs., Inc.*, 543 U.S. 157, 162–68 (2004) (discussing distinctions between CERCLA's several causes of action). Through the EPA, the United States is a party to the administrative orders. However, when Chevron settled with the EPA, the parties contracted to preserve Chevron's right to pursue these § 9613(f)(3)(B), post-settlement contribution claims against the United States.

A. Mining Activities from 1919–2014

Molybdenum is a valuable mineral used in the production of military-grade steel and other materials. Molybdenum mining activities on the Questa mining lands progressed in three stages: (1) initial underground mining and exploration from 1919 to 1964; (2) open-pit mining from 1964 to 1983; and (3) renewed underground mining from 1983 to 2014.

1. Initial Underground Mining and Exploration (1919–1964)

In 1919, the R&S Molybdenum Company of Denver opened an underground mine. The mine covered approximately 400 acres of mostly public land on which R&S Molybdenum held unpatented mining claims.[4] The underground mine produced relatively small quantities of molybdenum and associated waste for several decades before R&S Molybdenum deemed its reserves exhausted in the 1950s and underground mining operations effectively ceased.

Meanwhile, Congress passed the Defense Production Act of 1950 (DPA) to "ensure the vitality of the domestic industrial base" to supply necessary "materials and services for the national defense." 50 U.S.C. § 4502(a)(1). To

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[4] Unpatented mining claims on federal land convey a possessory right to the claim holder for the extraction and development of underlying mineral deposits, but the United States retains title to the lands. Patented lands, however, are owned in title by the claim holder. These lands may include the subsurface estate, the surface estate, or both. *See, e.g.*, *Entek GRB, LLC v. Stull Ranches, LLC*, 763 F.3d 1252, 1253–55 (10th Cir. 2014). The "patent" scheme for mining claims is discussed in greater detail below.

facilitate production of such materials, the DPA authorized a new federal agency within the Department of the Interior, the Defense Mineral Exploration Administration (DMEA). As part of its efforts to encourage exploration and development of necessary materials, including molybdenum, the DMEA provided loans to help finance private companies.

In 1957, R&S Molybdenum's successor-in-interest, the Molybdenum Corporation of America (Molycorp), entered into such a loan agreement with the DMEA. Molycorp and the DMEA executed an Exploration Project Contract, under which the federal government agreed to provide a loan covering up to $255,250 (*i.e.*, half the estimated exploration costs) in exchange for Molycorp's agreement to conduct strategic exploratory mining on the Questa mining lands. Under the contract, all work was subject to government approval. App., Vol. 1, at 100 ("The location, direction, inclination, extent, and methods of sampling the work under the contract are subject to Government approval."). Molycorp also agreed to repay the loan in the form of production royalties, provide monthly progress reports, and consult with and inform the government on all phases of the work as it progressed. At this point, Molycorp held twenty-one mining claims near Questa, all but two of which were unpatented.

Pursuant to the DMEA exploration contract, Molycorp conducted extensive exploration from 1957 to 1960 and eventually discovered a molybdenum ore deposit estimated to be 260 million tons in size. The Department of the Interior certified the discovery in 1960 and Molycorp began mining preparations.

2. Open-Pit Mining (1964–1983)

In 1964, Molycorp opened an open-pit mine to extract molybdenum from the ore deposit. The mine was a success and, at full capacity, produced more than four million tons of molybdenum annually (while simultaneously generating significant amounts of waste). By 1966, Molycorp fully repaid the government's loan under the DMEA contract via royalties from mineral production and sales. Molycorp expanded its mining activities to adjacent lands (not covered by the initial federal contract) on which it held mostly unpatented mining claims.

3. Renewed Underground Mining (1983–2014)

In 1983, Molycorp ceased open-pit mining operations and opened a new underground mine. Union Oil Company of California acquired the mine and, in 2005, Chevron acquired Union Oil. After several years with little or no mineral production, Chevron closed the underground mine in 2014.

B. Waste and Associated Disposal

The mining activities produced corresponding amounts of waste containing hazardous substances, now subject to CERCLA remediation. Approximately 150 thousand tons of waste rock were generated from the early underground mining operations, 328 million tons of waste rock and 75 million tons of "tailings"[5] from the open-pit mining, and 25 million tons of tailings from the renewed underground mining.

The substantial amount of waste generated by these mining activities was not unexpected. When Molycorp first discovered the molybdenum ore deposit in 1960, for example, government engineers produced a "Final Geological and Engineering Report" estimating over 99% of the material extracted from the 260 million ton ore deposit would need to be discarded as waste. *See* App., Vol. 3, at 681–84. Nonetheless, the federal government actively encouraged—and, indeed, funded—Molycorp's mining activities at this site.

Hazardous substance disposal from the mines can be divided into two categories: (1) waste rock disposal; and (2) mine tailings disposal.

1. Waste Rock Disposal

Chevron and its corporate predecessors disposed of over 328 million tons of waste rock on land surrounding the open-pit mine. Although Molycorp initially held only unpatented mining claims on the these lands, it eventually acquired fee title to 2,258 acres of national forest land around the perimeter of its open-pit mine (referred to as "the selected lands") from the United States.[6] In

[5] Mine tailings are fine grains of mining rock and water generated during the milling process as molybdenum is separated from the mined ore.

[6] The parties dispute whether Molycorp could have patented its claims on (continued...)

exchange for the selected lands, Molycorp traded to the United States approximately 246 acres of private land usable for public recreation, hunting, or other forest purposes. This land exchange was finalized in 1974.

2. *Mine Tailings Disposal*

Chevron and its corporate predecessors also disposed of over 100 million tons of mine tailings by transporting the tailings via pipelines to one of two different "tailings ponds"[7] approximately nine miles away from the open-pit mine. Of the two tailings ponds, the first was located on approximately 627 acres of land acquired from the Bureau of Land Management (BLM) in 1966. The second pond was located on 439 acres of land acquired from the State of New Mexico in 1968. Between 1965 and 1973, Molycorp sought and received several "special use" land authorization permits from the Forest Service for multiple tailings pipelines, which crossed over 4.27 miles of national forest lands to reach the two tailings ponds.

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[6](...continued)
the selected lands. Chevron contends the selected lands were nonmineral in character and thus unpatentable, while the government suggests Molycorp could have patented the claims. Resolution of this dispute is ultimately irrelevant, however, because regardless of whether Molycorp *could have* acquired title by patenting the claims, it is undisputed that Molycorp *in fact* acquired title through the land exchange. As we explain, this land exchange highlights both the government's ownership (and active exercise of such) over relevant portions of the Questa mining lands during the time of hazardous substance disposal and also evinces the government's assistance in arranging such disposal.

[7] Tailings ponds are confined areas to hold mine tailings.

II. Analysis

Chevron seeks recognition of the United States as a PRP, both as an "owner" and "arranger," liable for its equitable portion of costs to remediate the hazardous substances located at the Questa Site. These are questions of law that we review de novo in light of the factual record presented in the parties' cross-motions for summary judgment, a record which is not in dispute and our review of which is also de novo. *See Universal Underwriters Ins. Co. v. Winton*, 818 F.3d 1103, 1105 (10th Cir. 2016); Fed. R. Civ. P. 56(a). For the reasons set forth below, we conclude the United States is a PRP as an owner, but not as an arranger.

We start with the relevant statutory background.

A. Statutory Background: CERCLA and the General Mining Act of 1872

1. CERCLA

CERCLA was designed "to promote the 'timely cleanup of hazardous waste sites' and to ensure that the costs of such cleanup efforts were borne by those responsible for the contamination." *Burlington N. & Santa Fe Ry. v. United States*, 556 U.S. 599, 602 (2009) (citation omitted). "The remedy that Congress felt it needed in CERCLA is sweeping: *everyone* who is potentially responsible for hazardous-waste contamination may be forced to contribute to the costs of cleanup." *United States v. Bestfoods*, 524 U.S. 51, 56 n.1 (1998) (citation omitted). "[B]ecause CERCLA is remedial legislation, it should be construed liberally to carry out its purpose." *Atl. Richfield Co. v. Am. Airlines, Inc.*, 98 F.3d 564, 570 (10th Cir. 1996).

Proving that a defendant is liable in a contribution action under § 9613(f)(3)(B) "is dependent on the establishment of a prima facie case of liability under [§ 9607(a)]." *Morrison Enters. v. McShares, Inc.*, 302 F.3d 1127, 1132 (10th Cir. 2002) (alteration in original) (citation omitted). To do so, "a plaintiff must prove [that] (1) the site is a facility, (2) [the] defendant is a [PRP], (3) the release or threatened release of a hazardous substance has occurred, *and* (4) the release or threatened release caused the plaintiff to incur necessary response costs consistent with the" NCP. *Young v. United States*, 394 F.3d 858, 862 (10th Cir. 2005); *see Morrison*, 302 F.3d at 1135–36 (similarly identifying these elements, but recognizing that the fourth is comprised of three sub-elements). It is undisputed that the Questa Site has released or threatened to release hazardous substances, and that Chevron has incurred necessary response costs consistent with the NCP, pursuant to the administrative orders between Chevron and the EPA. In this case, therefore, only the definition of the relevant facility and the United States's status as a PRP as regards that facility bear on whether it is liable to contribute an equitably allocated amount toward Chevron's incurred and future response costs. We first address the relevant facility and then devote the balance of our analysis to whether the United States is a PRP.

CERCLA authorizes the President to designate certain facilities for remediation by placement on the NPL. 42 U.S.C. § 9605. And CERCLA defines "facility" broadly to include not only "any building, structure, installation, equipment, pipe or pipeline . . . , well, pit, pond, lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, or aircraft," but also "any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located." 42 U.S.C. § 9601(9).

Under this "broad and detailed definition," *Bestfoods*, 524 U.S. at 56, moreover, for purposes of establishing liability (as opposed to equitable allocation), a person is liable if that person meets CERCLA's definition of a PRP with respect to even a "portion of the total facility." *See Burlington N. & Santa Fe Ry.*, 556 U.S. at 618. In assessing whether the United States is liable here, therefore, we treat the entire EPA-delineated Questa Site as a single facility, even though it also might be conceptualized as numerous distinct parcels of land, sites, or areas, and the contaminated natural formations and objects on or in them. *See* 42 U.S.C. § 9601(9). The Questa Site includes "the mine and waste rock disposal area," "the tailings disposal area," App., Vol. 4, at 908, "as well as all other areas where any hazardous substance, pollutant, or contaminant from [Chevron's] mining, milling, and tailings disposal operations has come to be located." App., Vol. 2, at 249. The Questa Site thus encompasses all of the surface estates that are central to the dispute over whether the United States was an owner of the site.

Turning to whether the United States is a PRP, and regardless of whether a facility lands on the NPL, CERCLA holds "covered persons"—*i.e.*, persons[8] liable for a release or threatened release of hazardous substances from the facility—strictly liable for remedial action and other necessary response costs. 42 U.S.C. § 9607(a)(4). There are four types of covered persons: (1) owners; (2) operators; (3) arrangers; and (4) transporters. 42 U.S.C. § 9607(a). These categories of covered persons, the "potentially responsible parties," are broad. *See United States v. Atl. Research Corp.*, 551 U.S. 128, 134 & n.2 (2007) ("CERCLA § 107(a) lists four broad categories of persons as PRPs, by definition liable to other persons for various costs."); *Pub. Serv. Co. of Colo. v. Gates Rubber Co.*, 175 F.3d 1177, 1181 & n.6 (10th Cir. 1999) ("The categories of PRPs broadly include current and former owners and operators of a facility or vessel involved in hazardous substance disposal and persons who arranged for or accepted hazardous substances for disposal or transportation."). Only the first and third categories of covered persons—owners and arrangers—are at issue in this appeal. Each is discussed in greater length below.

"CERCLA liability may be inferred from the totality of the circumstances; it need not be proven by direct evidence." *Tosco Corp. v. Koch Indus., Inc.*, 216

[8] The term "person" includes "an individual, firm, corporation, association, partnership, consortium, joint venture, commercial entity, United States Government, [s]tate, municipality, commission, political subdivision of a [s]tate, or any interstate body." 42 U.S.C. § 9601(21).

F.3d 886, 892 (10th Cir. 2000). This is particularly true for cases involving older hazardous substance disposal, "as eyewitness testimony or other direct evidence concerning specific waste disposal practices . . . during the 1940s—well before the enactment of environmental laws—is rarely available." *Id.* "[C]ircumstantial evidence showing disposals of hazardous waste occurred at the [facility] during [a party]'s ownership or operation" of that facility is sufficient, if credited by the factfinder, to trigger liability. *Id.* Such otherwise-covered persons may avoid liability only if they qualify for one of CERCLA's enumerated defenses, e.g., those set forth in 42 U.S.C. § 9607(b), none of which is asserted here. Moreover, again, the factual record is not in dispute, allowing us to definitively resolve whether the United States is a PRP as a matter of law.

Finally, under the contribution provision of CERCLA at issue here, § 9613(f)(3)(B), all PRPs are jointly liable, and the court "may allocate response costs among liable parties using such equitable factors as the court determines are appropriate." 42 U.S.C. § 9613(f)(1); *see Burlington N. & Santa Fe Ry.*, 556 U.S. at 613–15 (discussing CERCLA's various costs-shifting frameworks). CERCLA subjects the United States to this statutory scheme "in the same manner and to the same extent, both procedurally and substantively, as any nongovernmental entity, including liability under section 9607. . . ." 42 U.S.C. § 9620(a)(1); *see, e.g.*, 42 U.S.C. § 9620(e)(6) (permitting the EPA to settle with another PRP to remediate a "Federal facility," giving rise to a contribution claim against the United States).

2. *The General Mining Act of 1872*

Chevron's claims arose from its right to exploit mineral deposits under the public lands of the United States. Under the General Mining Act of 1872, "all valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, shall be free and open to exploration and purchase, and the lands in which they are found to occupation and purchase, by citizens of the United States." 30 U.S.C. § 22. In essence, the Act "provides that citizens may enter and explore the public domain, and search for minerals; if they discover 'valuable mineral deposits,' they may obtain title to the land on which such deposits are located." *Andrus v. Shell Oil Co.*, 446 U.S. 657, 658 (1980).

Locators of mining claims, "so long as they comply with the laws of the United States, and with [s]tate, territorial, and local regulations . . . , shall have the exclusive right of possession and enjoyment of all the surface included within the lines of their locations." 30 U.S.C. § 26.

> A mining claim is a parcel of land containing precious metal in its soil or rock. A location is the act of appropriating such parcel, according to certain established rules. It usually consists in placing on the ground, in a conspicuous position, a notice setting forth the name of the locator, the fact that it is taken or located, with the requisite description of the extent and boundaries of the parcel, according to the local customs, or, since the statute of 1872, according to the provisions of that act.

Smelting Co. v. Kemp, 104 U.S. 636, 649 (1881). Under the General Mining Act of 1872, citizens may take steps to "locate" their mining claims by, at a minimum:

(1) distinctly marking the location on the ground so that its boundaries can be readily traced; (2) recording and submitting the name or names of the locators, the date of the location, and such a description of the claim or claims located by reference to some natural object or permanent monument as will identify the claim; and (3) maintaining the claim by annually performing at least $100 worth of labor or improvements, or paying a claim maintenance fee. *See* 30 U.S.C. §§ 28, 28f.

Citizens may also seek to convert their general, "unpatented" mining claims into "patented" claims by following the process set forth in 30 U.S.C. § 29. The holder of an unpatented claim has superior rights as against third parties but not as against the United States, which retains paramount title. *See United States v. Etcheverry*, 230 F.2d 193, 195 (10th Cir. 1956) ("[T]he mere location of a mining claim gives to the locator only the right to explore for and mine minerals, and to purchase the land if there has been a compliance with the provisions of the statute. As against third parties, the locator or his assigns have exclusive right to use the surface of this land, but as against the United States, his right is conditional and inchoate." (citing *Shiver v. United States*, 159 U.S. 491 (1895))). Issuance of a patent transfers title in the underlying public land from the United States to the patent holder. *See, e.g.*, *Iron Silver Mining Co. v. Campbell*, 135 U.S. 286, 301 (1890) ("[W]hen the government has issued and delivered its patent for lands of the United States, the control of the department over the title to such land has ceased."); *Smelting Co.*, 104 U.S. at 640–41 (1881) ("The execution and record of the patent are the final acts of the officers of the government for the transfer of its title, and as they can be lawfully performed only after certain steps have been taken, that instrument . . . not merely operates to pass the title, but is in the nature of an official declaration by that branch of government to which the alienation of the public lands, under the law, is intrusted, that all the requirements preliminary to its issue have been complied with.").

Nonmineral lands, however, may only be patented if the property is less than five acres and is included in a patent application for land with valuable minerals (subject to the same survey and notice requirements set forth in 30 U.S.C. § 29). *See* 30 U.S.C. § 42.

Given the legal background, this case requires us to harmonize liability provisions under CERCLA with the rights created by the General Mining Act of 1872 to determine whether the United States is a PRP and therefore required to equitably contribute toward cleaning up hazardous substances from mining operations on or under such land. We address owner liability first, and then turn to arranger liability.

B. "Owner" Liability

Chevron seeks recognition of the United States as an "owner" strictly liable for hazardous substances on the Questa mining lands. As we explain, we agree that the United States qualifies as a PRP because it owned portions of the land comprising the Questa Site. *See Burlington N. & Santa Fe Ry.*, 556 U.S. at 618.

Owner liability attaches to "any person owning" the contaminated facility. *See* 42 U.S.C. § 9601(20)(A); *Bestfoods*, 524 U.S. at 68 (explaining that the PRP inquiry "rests on the relationship between" the defendant and the "facility itself"); *Morrison*, 302 F.3d at 1133 ("Because liability is strict," a plaintiff "need not show that the defendant caused the release of hazardous wastes that required response actions."). Both current and past owners are subject to owner liability—it reaches "any person who at the time of disposal of any hazardous substance owned . . . any facility at which such hazardous substances were disposed of[.]" 42 U.S.C. § 9607(a).

The ordinary or natural meaning of "owner" includes, at a minimum, a legal title holder. *See Own*, Black's Law Dictionary (10th ed. 2014) ("To rightfully have or possess as property; to have legal title to."); *Owner*, Black's Law Dictionary (10th ed. 2014) ("Someone who has the right to possess, use, and convey something; a person in whom one or more interests are vested. An owner may have complete property in the thing or may have parted with some interests in it (as by granting an easement or making a lease).").

Dictionaries published around the time of CERCLA's enactment in 1980 affirm this natural meaning. *See Ownership*, American Heritage Dictionary (2d. ed. 1982) ("The state or fact of being an owner. . . . Legal right to the possession of a thing."); *Owner*, Oxford American Dictionary (1st ed. 1980) ("[A] person who owns something as his property."); *Own*, Black's Law Dictionary (5th ed. 1979) ("To have good legal title; to hold as property; to have a legal or rightful title to; to have; to possess."); *Owner*, Black's Law Dictionary (5th ed. 1979) ("The person in whom is vested the ownership, dominion, or title of property; proprietor. He who has dominion of a thing, . . . which he has a right to enjoy and do with as he pleases, even to spoil or destroy it, as far as the law permits, unless he be prevented by some agreement or covenant which restraints his right. . . . The primary meaning of the word as applied to land is one who owns the fee and who has the right to dispose of the property, but the term also includes one having a possessory right to land or the person occupying or cultivating it."). For purposes of CERCLA, then, an owner includes the legal title holder of contaminated land.[9] This broad liability is limited by only a handful of enumerated exceptions, which, again, the United States does not assert here.[10]

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[9] As the government points out, the statutory language is circular, in effect, a "tautology," because it defines an owner as an owner. *See Bestfoods*, 524 U.S. at 56. That may be true but as we discuss below, in context, the language still yields its ordinary meaning—an owner includes the title holder. To the extent a statutory definition is, by itself, circular or "useless[ ]," we are left "to do the best we can to give the term its 'ordinary or natural meaning.'" *See id.* at 66.

[10] *See, e.g.*, 42 U.S.C. §§ 9601(20)(A) (person holding indicia of ownership primarily to protect his security interest), 9601(20)(D) (a unit of state or local government that acquired ownership or control involuntarily by virtue of its function as sovereign—*e.g.*, through bankruptcy, tax delinquency, or abandonment), 9601(20)(E)(i) (lender holding indicia of ownership primarily to (continued...)

If the statutory term were not clear enough, the Supreme Court has admonished that "the law of CERCLA liability" incorporates "traditional standards and expectations," that a "CERCLA-specific rule of . . . liability . . . does not arise from congressional silence," and, rather, that "CERCLA's silence is dispositive." *Bestfoods*, 524 U.S. at 70. "It is 'a cardinal principle of statutory construction' that 'a statute ought, upon the whole, to be so construed that, if it can be prevented, no clause, sentence, or word shall be superfluous, void, or insignificant.'" *TRW Inc. v. Andrews*, 534 U.S. 19, 31 (2001) (citation omitted). Under this "rudimentary canon of statutory construction that [ ] superfluities are to be avoided," *Lockheed Martin Corp. v. Admin. Review Bd.*, 717 F.3d 1121, 1130 (10th Cir. 2013), we turn to contextual clues about the meaning of the term "owner." Other CERCLA provisions shed light on this inquiry. For example, among minimum standards for responding to a hazardous substance release, CERCLA requires "a method for and assignment of responsibility for reporting the existence of such facilities which may be located on *federally owned or controlled properties* and any releases of hazardous substances from such facilities." 42 U.S.C. § 9605(a)(6) (emphasis added).

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[10](...continued)
protect his security interest), 9601(20)(E)(ii) (lender that did not participate in management prior to foreclosure), 9607 (owners of contiguous real property who establish certain conditions by a preponderance of the evidence), 9624 (owners of equipment unless they caused the release or are otherwise liable).

The distinction between *federally owned* and *federally controlled* properties indicates that ownership and control are independent inquiries—the United States may own a facility without controlling that facility. *Cf.* 42 U.S.C. § 9620(a)(1) ("[T]he United States . . . shall be subject to, and comply with, this chapter in the same manner and to the same extent, both procedurally and substantively, as any nongovernmental entity, including liability under section 9607 of this title."). CERCLA also provides, at the request of a state, that the President "generally shall defer" final listing of an eligible site on the NPL if the President determines certain conditions have been satisfied. *See* 42 U.S.C. § 9605(h)(1). But the President "may decline to defer, or elect to discontinue a deferral" if the President determines "deferral would not be appropriate because the [s]tate, *as an owner or operator or a significant contributor* of hazardous substances to the facility, is a potentially responsible party." 42 U.S.C. § 9605(h)(4)(A) (emphasis added).

Differentiating among *owners*, *operators*, and *significant contributors* demonstrates that a person may be considered an owner for purposes of CERCLA liability, *see Bestfoods*, 524 U.S. at 56 n.1, without having contributed in any way to the hazardous substances. *See Atl. Research Corp.*, 551 U.S. at 136 ("[CERCLA] defines PRPs so broadly as to sweep in virtually all persons likely to incur cleanup costs. . . . [E]ven parties not responsible for contamination may fall within the broad definitions of PRPs in [§ 9607(a)]."). Likewise, CERCLA contains provisions for expedited final settlement with PRPs in certain circumstances. *See* 42 U.S.C. § 9622(g)(1). Expedited final settlement may be appropriate when the PRP "(i) is the *owner* of the real property on or in which the facility is located; (ii) did not *conduct or permit* the generation, transportation, storage, treatment, or disposal of any hazardous substance at the facility; and (3) did not *contribute* to the release or threat of release of a hazardous substance at the facility through any action or omission." 42 U.S.C. § 9622(g)(1)(B) (emphasis added). These three, distinct, enumerated requirements indicate that they are separate—*i.e.*, an owner of real property on or in which the facility is located does not have to have conducted, permitted, or contributed to the production of hazardous substances in order to be considered an owner for purposes of CERCLA liability. Interpreting these provisions to mean otherwise would render portions of the statute superfluous, void, or insignificant.

It is undisputed that the United States held legal title to relevant portions of the Questa mining lands at the time of significant hazardous substance disposal. *See, e.g.*, App., Vol. 2, at 422 ("Prior to approving the 1974 Land Exchange, United States employees knew that [Chevron] had disposed of waste rock on the Selected Lands covered by [Chevron's] unpatented mining claims . . . ."). Nevertheless, the government argues "bare legal title" is insufficient to trigger owner liability. Instead, it contends the unique nature of unpatented mining claims on federal lands requires an exception to CERCLA's ownership liability provision. *But see* 42 U.S.C. § 9620(a)(1) (holding "the United States" liable "to the same extent, both procedurally and substantively, as any nongovernmental entity, including" as regards "liability under" 42 U.S.C. § 9607(a)(2)'s "owner or operator" provision).

Although CERLCA contains neither an expressed nor an implied exception to owner liability for holders of "bare legal title," the government urges us to adopt such an exception based on *United States v. Friedland*, 152 F. Supp. 2d 1234 (D. Colo. 2001). In *Friedland*, the district court held the United States, as "bare legal title holder to unpatented mining claims," did not qualify as an "owner" for purposes of CERCLA liability. *See* 152 F. Supp. 2d at 1242–46. In reaching this conclusion, however, *Friedland* found that, because CERCLA defines owner "tautologically . . . as 'any person . . . owning a facility,'" "CERCLA's text [ ] offers virtually no guidance in interpreting the extent of owner liability." *Id.* at 1242 (quoting 42 U.S.C. § 9601(20)(A)). And *Friedland* agreed with the Second Circuit's finding in *Commander Oil* that "the term 'owner' has no natural meaning" and "limited inherent content." *See Friedland*, 152 F. Supp. 2d at 1242 (citing *Commander Oil Corp. v. Barlo Equip. Corp.*, 215 F.3d 321, 327–28 (2d Cir. 2001)). To fill this void, the district court adopted an "indicia of ownership" analysis which required examining "the relationship between the United States, as owner of bare legal title of the unpatented mining claim/property, and those entities utilizing the property subject to the unpatented mining claim," to discern "whether the United States possessed indicia of ownership sufficient to merit the appellation 'owner' for purposes of CERCLA." *Id.* at 1244. Conducting this analysis, *Friedland* found "the United States [was] not an 'owner' in the fullest sense of the term," so it was "inappropriate to deem the United States an 'owner' for purposes of CERCLA liability." *Id.* at 1246.

The government urges us to adopt *Friedland*'s indicia of ownership test. But we find it neither persuasive in principle nor in application. First, as we explained above, this analysis has no basis in the statute. In fact, CERCLA's statutory context, which supports broad application of owner liability subject only to certain, specifically enumerated exceptions belies a supra-statutory gloss. Moreover, Congress included the phrase "indicia of ownership" when crafting some of its few exceptions to broad owner liability. *See, e.g.*, 42 U.S.C. §§ 9601(20)(A) (person holding indicia of ownership primarily to protect his security interest), 9601(20)(E)(i) (lender holding indicia of ownership primarily to protect his security interest). If Congress sought to require indicia of ownership by all would-be "owners," it could have done so. The indicia of ownership test also runs perilously close to collapsing the "owner" and "operator" categories by requiring owners to exercise some threshold level of indicia of ownership beyond their rights as title holder. *See Atl. Research*, 551 U.S. at 136 (noting that even "'innocent private parties," e.g., "a landowner whose land has been contaminated by another," are within the ambit of this "strict liability statute" (absent a statutorily-enumerated defense), because "even parties not responsible for contamination may fall within the broad definitions of PRPs" (citation omitted)).

Second, at least some of *Friedland*'s reasoning conflicts with, and is thus undermined by, binding Supreme Court precedent. While *Friedland* contends "the United States is not allowed to exclude individuals from [land subject to unpatented mining claims] and may only regulate mining activities in the national forests in order to protect surface resources," *see* 152 F. Supp. 2d at 1246, the Supreme Court has repeatedly emphasized Congress's broad, plenary Property Clause[11] powers over national forest land, including lands subject to unpatented mining claims. *See, e.g.*, *Cal. Coastal Comm'n v. Granite Rock Co.*, 480 U.S. 572, 581 (1987) ("[T]he Property Clause gives Congress plenary power to legislate the use of the federal land on which [a mining company] holds its unpatented mining claim.").[12] Even if it is true, as the government argues, that

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[11] U.S. Const. art. IV, § 3, cl. 2 ("The Congress shall have Power to dispose of and make all needful Rules and Regulations respecting the Territory or other Property belonging to the United States . . . .").

[12] *See also, e.g.*, *United States v. Locke*, 471 U.S. 84, 104 (1985) ("Although owners of unpatented mining claims hold fully recognized possessory interests in their claims, we have recognized that these interests are a 'unique form of property.' The United States, as owner of the underlying fee title to the public domain, maintains broad powers over the terms and conditions upon which the public lands can be used, leased, and acquired. . . . Claimants thus must take their interests with the knowledge that the Government retains substantial regulatory power over those interests." (citation omitted)); *Best v. Humboldt Placer Mining Co.*, 371 U.S. 334, 336 (1963) ("Respondents' mining claims are unpatented, the title to the lands in controversy still being in the United

(continued...)

Chevron and its corporate predecessors "had exclusive use and possession of the [Questa mining lands] for mining purposes, without any interference or control by the United States," Aple. Br. at 21, the government's choice not to exercise its Property Clause powers does not invalidate their existence. There is no dispute that the United States held fee title to relevant portions of the Questa mining lands during the time of hazardous substance disposal, part of the area that today comprises the Questa Site. We do not doubt that it could have exercised greater powers, regulatory or otherwise, over the lands if it wanted to do so.[13]

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[12](...continued)
States. . . . [T]he Department has been granted plenary authority over the administration of public lands, including mineral lands; and it has been given broad authority to issue regulations concerning them."); *Belk v. Meagher*, 104 U.S. 279, 283–84 (1881) ("Congress has seen fit to make the possession of that part of the public lands which is valuable for minerals separable from the fee, and to provide for the existence of an exclusive right to the possession, while the paramount title to the land remains in the United States. . . . The right of location upon the mineral lands of the United States is a privilege granted by Congress, but it can only be exercised within the limits prescribed by the grant.").

[13] Under the Property Clause, Congress always retains—at least over the "lands of the United States"—the powers "to control their occupancy and use, to protect them from trespass and injury, and to prescribe the conditions upon which others may obtain rights in them." *Utah Power & Light Co. v. United States*, 243 U.S. 389, 405 (1917). This "power over the public land . . . entrusted to Congress is without limitations." *Alabama v. Texas*, 347 U.S. 272, 273 (1954); *see also* *United States v. Bd. of Cty. Comm'rs of Cty. of Otero*, 843 F.3d 1208, 1212 (10th Cir. 2016) ("[T]he Property Clause gives the federal government plenary power, including legislative and police power, over federal property."). And, as we have explained, the Supreme Court has made clear that while holders of unpatented mining claims have substantial property interests in their claims, Congress's broad, plenary Property Clause powers continue to reach the underlying federal land.

Finally, we find the government's argument undermines the understanding of what a CERCLA "facility" is. CERCLA defines "facility" to broadly include "any site or area" (*i.e.*, land) "where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located." 42 U.S.C. § 9601(9). Its statutory coverage is expressly *not* limited to a "facility" in the more traditional, narrow sense—*e.g.*, "any building, structure, installation, equipment, pipe or pipeline . . . , well, pit, pond, lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, or aircraft." *Id.* An owner of any land contaminated with hazardous substances thus qualifies as an owner of a "facility," even if that person does not own any of the mining equipment or structures. In contrast to this clear statutory command, the government asks us to define "the facility" solely "with respect to Chevron's mining activities," and not with respect to the land, such that "any non-mining use rights held by the United States within the boundaries of Chevron's mining claims are not part of the 'bundle of sticks' that is material to determining whether the United States is an 'owner' of the Questa Mine 'facility.'" Aple. Br. at 42.

We conclude that, at a minimum, the term "owner" covers fee title holders for purposes of CERCLA liability, irrespective of any additional indicia of ownership. To find otherwise would be inconsistent with CERCLA's statutory scheme and an ordinary application of its terms. Of course, a "bare legal title" holder may in fact be liable for only a small, or perhaps no, share of remediation costs as a matter of equity. But a liberal construction of CERCLA's liability scheme requires any consideration of the extent and kind of an owner's involvement in hazardous substance production and disposal be made at the second stage of the CERCLA liability inquiry (*i.e.*, allocation under 42 U.S.C. § 9613(f)(1)), rather than the first (*i.e.*, precluding "owner" liability entirely). This position is consistent with Supreme Court precedent and case law from other circuits.[14] *See Atl. Research*, 551 U.S. at 136 (explaining that "even parties not responsible for contamination may fall within the broad definition of PRPs," e.g., owners).

[14] For example, the Fourth Circuit has addressed, and rejected, the argument that a person who merely "held legal title to the property for only a short period of time" was not an "owner" for purposes of CERCLA liability. *See Nurad, Inc. v. William E. Hooper & Sons Co.*, 966 F.2d 837, 844 (4th Cir. 1992). In holding the short-term title holder liable as an owner, the court noted that "the word 'owned' is [not] a word that admits of varying degrees. Such equitable considerations as the duration of ownership may well be relevant at a later stage of the proceedings when the district court allocates response costs among liable parties, but we reject any suggestion that a short-term owner is somehow not an owner for purposes of § 9607(a)(2)." *Id.* (citation omitted); *see also, e.g.*, *Los Angeles v. San Pedro Boat Works*, 635 F.3d 440, 444, 448–52 (9th Cir. 2011) (acknowledging "Congress's intent to hold liable the *passive fee title owner of real property*," declining to apply *Commander Oil*'s "nebulous and flexible" framework, and, in holding owner liability improper as applied to holders of revocable permits for specific use of real property, contrasting the status of persons holding "less-than fee-title possessory interests in real property, conveyed by the holder of fee title" with persons holding "absolute title ownership to real property" (*i.e.*, quintessential "owners") (emphasis added)); *Canadyne-Ga. Corp. v. NationsBank, N.A. (S.)*, 183 F.3d 1268, 1273–74 (11th Cir. 1999) (finding "legal title" sufficient to trigger owner liability).

In any event, the government engaged in much more than mere passive ownership here. The United States actively exercised its ownership when, for example, it sold portions of its land, including the 2,258 acres of land for waste rock disposal around the perimeter of the open-pit mine and the 627 acres of land for use as a tailings pond, to Molycorp in exchange for valuable consideration. Alienability is a key tenant of ownership—it is a "fundamental maxim of property law that the owner of a property interest may dispose of all or part of that interest as he sees fit." *Phillips v. Wash. Legal Found.*, 524 U.S. 156, 167 (1998).

In addition, the government actively encouraged mining activities on its lands when it passed the DPA and provided the initial loan to Molycorp, Chevron's corporate predecessor, to fund their molybdenum exploration and mining. For decades after that, the United States knew that Chevron was depositing millions of tons of waste rock and tailings on the surface estates, land over which the United States still held, at minimum, ownership via legal title. Regardless of whether contracting out mining activities might, or might not, shield a party from *operator* liability, it cannot shield a landowner—here, the legal titleholder—from *owner* liability (although it might reduce the party's equitable share at the allocation stage). And the government repeatedly exercised its plenary regulatory authority over the lands when it approved several special use permits for Molycorp's tailings pipelines. These actions all indicate the government's continued oversight and involvement in operations on the Questa mining lands that produced substantial amounts of hazardous substances. Though such efforts are not at all required for ownership liability, *see, e.g.*, *Atl. Research*, 551 U.S. at 136, that the United States undertook them here buttresses our conclusion that it was an owner.

Accordingly, we conclude the United States was an owner of portions of the Questa Site during the relevant period when hazardous substances came to be located there. As a matter of law, therefore, the United States is a PRP with respect to the Questa Site and is strictly liable to contribute its equitably allocated share of Chevron's response costs, pursuant to § 9613(f)(3)(B).

C. "Arranger" Liability

In addition to liability as an "owner" of contaminated property, Chevron asks us to find the United States liable as an "arranger" of hazardous substance disposal at the Questa Site. Though we have already determined the United States qualifies as an owner and is therefore a PRP, we must address this separate theory of recovery under § 9613(f)(3)(B) because it may affect the determination of the United State's equitable allocation of the response costs. As we explain, however, we conclude that the United States is not liable as an arranger under CERCLA because it neither owned nor possessed the hazardous substances disposed of.

Arranger liability under CERCLA attaches to,

> any person who by contract, agreement, or otherwise arranged for disposal or treatment, or arranged with a transporter for transport for disposal or treatment, of hazardous substances owned or possessed by such person, by any other party or entity, at any facility or incineration vessel owned or operated by another party or entity and containing such hazardous substances.

42 U.S.C. § 9607(a)(3). In other words, to be held liable under CERCLA as an arranger, we require a party to satisfy three conditions: (1) the party must be a "person" as defined in CERCLA; (2) the party must "own" or "possess" the hazardous substance prior to the disposal; and (3) the party must, "by contract, agreement or otherwise," arrange for the transport or disposal of such hazardous substances. *Raytheon Constructors, Inc. v. Asarco Inc.*, 368 F.3d 1214, 1219 (10th Cir. 2003). Because the United States at best satisfies only two of these three conditions—the first and the third—we hold that arranger liability does not apply.

To begin with, the United States is a "person" as defined in CERCLA, thus satisfying the first condition. *See* 42 U.S.C. § 9601(21) ("The term 'person' means . . . United States Government . . . ."); 42 U.S.C. § 9620(a)(1) ("Each department, agency, and instrumentality of the United States (including the executive, legislative, and judicial branches of government) shall be subject to, and comply with, this chapter in the same manner and to the same extent, both procedurally and substantively, as any nongovernmental entity, including liability under section 9607 of this title.").

As to the third condition, it is true that the United States helped arrange for the transport or disposal of waste rock and tailings at the Questa Site. And it is undisputed those materials contained or were themselves hazardous substances within the meaning of CERCLA. *See* 42 U.S.C. § 9601(14). But as the Supreme Court has explained, not all involvement in the disposal process triggers arranger liability. While it is "plain from the language of the statute that CERCLA liability would attach under § 9607(a)(3) if an entity were to enter into a transaction for the sole purpose of discarding a used and no longer useful hazardous substance," it is equally clear that, at the other extreme, "an entity could not be held liable as an arranger merely for selling a new and useful product if the purchaser of that product later, and unbeknownst to the seller, disposed of the product in a way that led to contamination." *Burlington N. & Santa Fe Ry.*, 556 U.S. at 609–10. "Less clear is the liability attaching to the many permutations of 'arrangements' that fall between these two extremes." *Id.* at 610.

In such cases, "whether an entity is an arranger requires a fact-intensive inquiry that looks beyond the parties' characterization of the transaction . . . and seeks to discern whether the arrangement was one Congress intended to fall within the scope of CERCLA's strict-liability provisions." *Id.* The Supreme Court has interpreted this inquiry to require more than "knowledge alone"; an arranger must have taken "intentional steps to dispose of a hazardous substance."

See id. at 611–12; *see also Martin K. Eby Constr. Co. v. OneBeacon Ins.*, 777 F.3d 1132, 1140 (10th Cir. 2015) (citing this rule in a state-law insurance case).

Chevron contends that sufficiently intentional steps have been taken to satisfy this requirement. It points to language from *Burlington Northern* that explains "to qualify as an arranger," a party must have entered into an arrangement "with the intention that at least a portion of the product be disposed of during the transfer process by one or more of the methods described in § 6903(3)," *Burlington N. & Santa Fe Ry.*, 556 U.S. at 612, *i.e.*, by discharge, deposit, injection, dumping, spilling, leaking, or placing it into or on any land or water, 42 U.S.C. § 6903(3).

According to Chevron, the undisputed facts demonstrate the federal government intentionally arranged for the disposal of hazardous substances on and from the Questa mining lands. *First*, the United States sold the selected lands to Molycorp with the knowledge that the lands were intended to be used as a disposal area. Molycorp initially proposed to use a canyon across the Red River as its primary waste-disposal site. Although a Forest Service report indicated that the Red River proposal was going to be the "least expensive means of dispos[al], . . . the impact on the environment and ecology of Red River Canyon would be tremendous" and the proposal was thus "vigorously opposed by the Forest Service and ecologist groups." App., Vol. 1, at 167. As an alternative, then, Molycorp began negotiations with the Forest Service in 1969 to facilitate a transaction in which Molycorp would give the United States "246.65 acres of land which it own[ed] in Taos County" in exchange for "2,258 acres of National Forest land" adjacent to the open-pit mine. *Id.* at 163. The Forest Service shared Molycorp's intent to use the selected lands as a disposal area and believed this use would benefit the United States. *See id.* at 164 ("The selected lands will be the final area of disposal for a part of the nonmineral overburden."); *id.* at 166 (acknowledging that "the mine is supplying a needed mineral resource to the Nation" and noting "several indirect benefits from the disposal of the overburden material").

Second, the United States sold an additional 627 acres of land to Molycorp with the intent that the lands be used as a tailings pond to dispose of mine tailings. A BLM land report analyzing the proposed sale identified the lands as "non-mineral in character" and "greatly needed as a tailings pond," explaining the government's understanding that Molycorp's "molybdenum mine is located nine miles to the east and tailings would be piped from the mine to the pond." *Id.* at 183–84. The BLM ultimately found that the sale would be "in the public interest" and, "[c]onsidering the urgent need of the applicant for the subject tract and its suitability for the proposed use as well as the resulting economic benefit to the general area from the expanded mining operation, the highest and best use is that of a tailings pond." *Id.* 183, 186.

Finally, the United States routinely approved special use land authorization permits for pipelines crossing over national forest lands with the specific intent that Molycorp would use the pipelines to transport tailings from the mine site to the disposal ponds. For example, a 1965 government Impact Report referred to the pipeline as a "proposed tailings line" and acknowledged specific risks associated with this particular use, including "the potential of the line breaking and spilling slurry into the river, which might result in local fish kill prior to repair of the line." *Id.* at 204–05. The report nonetheless concluded "[t]he over-all impact of this project . . . is beneficial," *id.* at 205, and indicated an express preference for Molycorp's pipeline plan. It did so to avoid "[t]he alternative of a mountain of tailings in the canyon around Sulfer Gulch," which would be "intolerable but legal." *See id.* at 205. And the government had no doubt that subsequent special use permits would likewise allow construction of pipelines to transport mine tailings. A 1973 letter to Molycorp approved "a fourth tailings line adjacent to [its] existing tailings pipeline." *Id.* at 208.

These government actions may well constitute sufficiently "intentional steps" to satisfy the third condition of arranger liability. The collective effect of the United States's actions—including the sale of the selected lands for a waste disposal site, sale of the land for the second tailings pond, and approval of the tailings pipelines—was not only to ensure the likelihood of hazardous substance disposal but also to facilitate it.

But that is not the end of our analysis. Arranger liability under CERCLA applies only to a person who arranges for disposal "of hazardous substances *owned or possessed by such person*." 42 U.S.C. § 9607(a)(3) (emphasis added). As we said in *Raytheon*, to be held liable under CERCLA as an arranger, "the party . . . must 'own' or 'possess' the hazardous substance at issue." 368 F.3d at 1219. Chevron suggests we revisit the ownership/possession requirement in its entirety. But, "[a]bsent *en banc* consideration, we generally 'cannot overturn the decision of another panel of this court,'" unless an intervening Supreme Court decision "is 'contrary' to or 'invalidates our previous analysis.'" *See United States v. Brooks*, 751 F.3d 1204, 1209 (10th Cir. 2014) (citations omitted). And although Chevron implies the Supreme Court's decision in *Burlington Northern* invalidated our explanation of CERCLA's ownership requirement set forth in *Raytheon*, we are not persuaded. Beyond reproducing the statutory text, *Burlington Northern* does not even mention the ownership requirement in CERCLA's arranger liability provision, let alone call it into question. *See* 556 U.S. at 611–12 (addressing whether a manufacturer that sold chemicals to distributors was an arranger).

Our position is consistent with several cases from other circuits. For example, the First Circuit recognized that the statutory phrase in § 9607(a)(3) "by any other party or entity" could ostensibly be read to modify "the preceding words 'owned or possessed by such person,' which would make liable any person who arranged for the disposal of a hazardous substance 'owned or possessed by such person [or] by any other party or entity.'" *Am. Cyanamid Co. v. Capuano*, 381 F.3d 6, 23–24 (1st Cir. 2004) (brackets in original). But the court proceeded to explain the "sentence structure of § 9607(a)(3) makes it clear" that the correct interpretation is to read "by any other party or entity" to modify "the words 'disposal or treatment,' which would make the sentence read 'any person who . . . arranged for disposal or treatment . . . by any other party or entity'" and leave the ownership/possession requirement intact. *Id.* at 24 (ellipses in original).

Likewise, the Third Circuit agrees that for arranger liability to attach under CERCLA, "[p]roof of ownership, or at least possession, of the hazardous substance is required by the plain language of the statute." *Morton Int'l, Inc. v. A.E. Staley Mfg. Co.*, 343 F.3d 669, 678 (3d Cir. 2003); *see also, e.g.*, *GenCorp, Inc. v. Olin Corp.*, 390 F.3d 433, 445 (6th Cir. 2004) ("CERCLA imposes liability on any person who 'arrange[s]' 'by contract, agreement or otherwise' for the 'disposal or treatment . . . [or] for transport for disposal or treatment' of *'hazardous substances' that is* [sic] *'owned or possessed' by that person*.'" (emphasis added; brackets and ellipses in original)); *Concrete Sales and Servs., Inc. v. Blue Bird Body Co.*, 211 F.3d 1333, 1337 (11th Cir. 2000) (per curiam) ("In the present case, therefore, the [party seeking imposition of arranger liability] must produce evidence that would allow a reasonable [factfinder] to infer from the totality of the circumstances that [the alleged arrangers] arranged for [the] disposal of *hazardous substances owned or possessed by* [*the alleged arrangers*]." (emphasis added)); *Uniroyal Chem. Co., Inc. v. Deltech Corp.*, 160 F.3d 238, 243 (5th Cir. 1998) (quoting 42 U.S.C. § 9607(a)(3) as providing arranger liability for "any person who by contract, agreement, or otherwise arranged for disposal or treatment, or arranged with a transporter for transport for disposal or treatment, *of hazardous substances owned or possessed by such person* . . . , at any facility" (emphasis added; ellipses in original)); *United States v. TIC Inv. Corp.*, 68 F.3d 1082, 1086 (8th Cir. 1995) (summarizing 42 U.S.C. § 9607(a)(3) as providing arranger liability for "those who arranged for disposal or treatment, or arranged for transport for disposal or treatment, *of hazardous substances which they owned or possessed*" (emphasis added)).

Chevron points to only one case which has rejected the ownership requirement. *See Cadillac Fairview/Cal., Inc. v. United States*, 41 F.3d 562 (9th Cir. 1994). In that case, the Ninth Circuit interpreted CERCLA's statutory language to extend arranger liability "to persons 'otherwise arrang[ing]' for disposal or treatment of hazardous substances *whether owned by the arranger or* '*by any other party or entity*, at any facility or incineration vessel owned or operated by another party or entity.'" *Id.* at 565 (emphasis added). In other words, *Cadillac Fairview* interpreted arranger liability to attach not only to hazardous substances owned or possessed by the alleged-arranger but also to such substances owned or possessed "by any other party or entity." *Id.* Even if this argument were not foreclosed by our decision in *Raytheon*, we find it unpersuasive based on the statute's plain language.

First of all, the more natural reading of the statutory language is that the hazardous substances must be owned or possessed by the person arranging for the disposal or treatment of those substances. In contrast, the clause "by any other party or entity" does not apply to ownership of the hazardous substances but, as most courts have held, refers back to the previous clause, "for disposal or treatment" (*i.e.*, the phrase thus most naturally reads as the arrangement "for disposal or treatment . . . by any other party or entity, at any facility or incineration vessel"). This reading makes sure that the party getting paid for disposal or treatment (and thereby taking possession or ownership of the hazardous substances) is liable while not insulating from liability the previous owner who arranged for the disposal or treatment. To read the provision otherwise would render the "owned or possessed" language entirely superfluous. Under well-established principles of statutory interpretation, Congress would not have included an ownership or possession requirement if that requirement could be met by *any* party's or entity's ownership or possession of the substances.[15] Our correct application of these canons of statutory construction is confirmed by

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[15] The canon against surplusage indicates that we generally must give effect to all statutory provisions, so that no part will be inoperative or superfluous—each phrase must have distinct meaning. *See, e.g.*, *Marx v. Gen. Revenue Corp.*, 133 S. Ct. 1166, 1178 (2013); *TRW Inc.*, 534 U.S. at 31; *Lockheed Martin Corp.*, 717 F.3d at 1130–31.

Cadillac Fairview itself, which is untethered from CERCLA's text. *See* 41 F.3d at 565.

Chevron also cites two cases, in addition to *Cadillac Fairview*, to support its claim that other courts have rejected an ownership or possession requirement. But as Chevron acknowledges, those cases merely "question[] whether it requires proof of actual ownership, or may be satisfied by other evidence," without rejecting the requirement altogether, *see* Aplt. Reply Br. at 25 n.15. For example, the Sixth Circuit acknowledged that "to say that [42 U.S.C. § 9607(a)(3)] requires ownership or possession of the waste does not establish what evidence will satisfy the requirement or, more particularly, whether constructive ownership or possession will suffice." *GenCorp, Inc.*, 390 F.3d at 448. In interpreting the ownership requirement, *GenCorp* found it appropriate to "infer that Congress meant the phrase 'ownership or possession' to include constructive ownership or possession," and that "GenCorp's control over the hazardous waste suffice[d] to establish constructive ownership and possession" sufficient to trigger arranger liability. *See id.* at 448–49. Likewise, the Eighth Circuit simply declined to require rigid "proof of *personal ownership* or *actual physical possession*." *United States v. Ne. Pharm. & Chem. Co.*, 810 F.2d 726, 743–44 (8th Cir. 1986) (emphasis added). But it found that the company "had actual 'control' over the . . . hazardous substances," and that this authority was sufficient to satisfy the ownership requirement and trigger arranger liability. *See id.* at 743.

Raytheon does not discuss whether anything less than actual ownership of the hazardous substances disposed of may satisfy CERCLA's requirements for arranger liability, nor has Chevron made a constructive possession argument. Chevron briefly notes that "the United States held fee title to lands from which waste rock was extracted and therefore owned that rock," but its briefs neither develop this argument nor apply it to CERCLA. *See* Aplt. Br. at 56 n.15.

Even if we were to reach this argument, Chevron failed to establish that the United States owned or possessed the hazardous substances, or the mining waste containing them. It cites to *United States v. McPhilomy*, 270 F.3d 1302 (10th Cir. 2001), but that criminal case did not involve valid mining claims and turned on a very different burden of proof even as to the issues it discussed. In any event, "the moment th[at] ore becomes detached from the soil in which it is embedded it becomes personal property, the ownership of which is in the [person] whose labor, capital, and skill has discovered and developed the mine[,] . . . free from any lien, claim, or title of the United States . . . ." *Forbes v. Gracey*, 94 U.S. 762, 765–66 (1876). The United States neither owned nor possessed the waste rock and tailings extracted from Chevron's molybdenum mining activities.

In sum, we conclude that the United States is not an "arranger" under CERCLA with regard to the contamination located at the Questa Site because it did not own or possess the hazardous substances disposed of.

III. Conclusion

We conclude that, as a matter of law, the United States is an "owner" under 42 U.S.C. § 9607(a)(2) because it owned portions of the Questa Site at the time hazardous substances were located there. The United States is not, however, an "arranger" under 42 U.S.C. § 9607(a)(3) because it did not own or possess the hazardous substances disposed of. The United States is thus a PRP under CERCLA (as an owner but not an arranger) and, as a matter of law, liable for an equitable allocation of Chevron's past, present, and future necessary response costs to remediate the Questa Site, pursuant to 42 U.S.C. § 9613(f)(3)(B).

Accordingly, we REVERSE in part and AFFIRM in part the district court's judgment and REMAND for further proceedings consistent with this opinion.

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IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF ARIZONA

El Paso Natural Gas Company, LLC, Plaintiff, v. United States of America, et al., Defendants.	No. CV14-8165-PCT-DGC **ORDER**

This case concerns environmental liability under the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA") for 19 uranium mines located near Cameron, Arizona, on the Navajo Nation Reservation (the "Mine Sites"). Plaintiff El Paso Natural Gas Company, LLC, whose predecessors operated the mines in the 1950s and 1960s, brings claims against Defendants United States of America, the Department of the Interior ("DOI"), the Bureau of Indian Affairs ("BIA"), the United States Geological Survey ("USGS"), and the Department of Energy ("DOE") (collectively, the "United States") for cost recovery and contribution. Doc. 55 ¶¶ 1-2.[1] The United States asserts a CERCLA counterclaim against El Paso for contribution. Docs. 53, 66.[2]

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[1] The Nuclear Regulatory Commission was dismissed on May 5, 2016. *See* Doc. 72.

[2] The 19 Mine Sites consist of sites 1-12, 14, and 17, originally permitted by Charles and Evan Huskon, and sites 20-22 and 24, originally permitted by Rare Metals Corporation. The Court will refer to the sites generally as "Mine Sites" and specifically as "Huskon" followed by the site number or "Ramco" (for Rare Metals) followed by the site number.

El Paso stipulates that it was an operator of the Mine Sites for purposes of CERCLA liability (Doc. 108), and the Court previously held that the United States is liable as an owner of the land where the mines are located (Doc. 135). The parties assert additional grounds for CERCLA liability against each other and ask the Court to make an equitable allocation of past and future response costs under CERCLA § 113.

The Court held an eight-day bench trial in February and March, 2019. Each side presented many witnesses, live or by deposition, and hundreds of exhibits. The parties also submitted extensive proposed findings of fact and conclusions of law, as well as post-trial briefing on specific issues addressed in this order. For reasons set forth below, the Court will allocate 65% of past and future response costs to El Paso and 35% of such costs to the United States.

I. Findings of Fact.

This order sets forth the Court's findings of fact and conclusions of law under Rule 52 of the Federal Rules of Civil Procedure. The Court provides some citations to the record, but the citations should not be regarded as the sole basis for the Court's ruling. The Court's findings and conclusions are based on all of the testimony and exhibits admitted in evidence.

A. The Parties.

El Paso is the corporate successor of Arrowhead Uranium Company ("Arrowhead"), Rare Metals Corporation of America ("Rare Metals"), and El Paso Natural Gas Company. Doc. 159 at 8.[3] Arrowhead and Rare Metals mined uranium at the Mine Sites. Arrowhead was one of the original uranium mining companies in the Cameron region of Northern Arizona, operating from 1952 to 1954. Ex. 28 at 7-8. Rare Metals was formed in 1954 to prospect, explore, and acquire properties containing uranium deposits and other valuable minerals. Rare Metals acquired Arrowhead in December 1954 and took over its uranium mining operations. *See* Exs. 1040-44. Rare Metals also engaged in uranium exploration

[3] Throughout this order, the Court will refer to Arrowhead, Rare Metals, and El Paso collectively as "El Paso" unless the context requires identification of a specific entity.

and development in Utah, New Mexico, California, and other locations. Exs. 1041 at 7; 1042 at 6, 8; 1043 at 5-7, 9. Rare Metals merged with El Paso in 1962. Ex. 1056. El Paso also takes responsibility for the mining activities of Cameron Mining Company at several of the Mine Sites. Doc. 159 at 8.

The land where the Mine Sites are located is owned by the United States in trust for the Navajo Nation. *See* 25 U.S.C. § 640d-9(a); Doc. 159 at 7. The DOI and the BIA, as part of their tribal trust responsibilities, oversaw some aspects of the mining permits and leases for the Nation. Doc. 159 at 8; Ex. 12 at 2. The USGS, which is part of the DOI, collects, analyzes, monitors, and provides information about natural resources. Docs. 1 ¶ 19; 23 ¶ 19. DOE is the successor agency to the former Atomic Energy Commission ("AEC"). Doc. 23 ¶ 20. After World War II, the AEC was responsible for creating and managing a program to procure uranium for nuclear weapons, known as the Domestic Uranium Procurement Program ("DUPP"). Ex. 74 at 6.

B. The Cold War and the Domestic Uranium Industry.

The United States' use of atomic bombs in Japan both hastened the end of World War II and sparked the Cold War with the Soviet Union. Both nations aggressively developed nuclear weapons. Obtaining uranium, a naturally occurring metal that was an indispensable component of such weapons, became a driving objective of the United States' national defense effort. Doc. 158 ¶ 12.

In 1946, Congress passed the Atomic Energy Act, which formed the AEC. *See* 60 Stat. 755. The Act also established the DUPP, a program for "the production, ownership, and use of fissionable material to assure the common defense and security and to insure the broadest possible mining of the fields." Ex. 74 at 6. Viewing foreign sources of uranium as unreliable, the United States sought, through the DUPP, to locate and develop domestic sources using a combination of government-led exploration and private enterprise incentives. Tr. at 94-95. At the time, the federal government was the only authorized purchaser of uranium in the United States. Atomic Energy Act of 1946 § 5(2); Ex. 74 at 14.

Between 1948 and 1956, the AEC published nine circulars offering guaranteed minimum prices and bonus payments for uranium ore (the "Circulars"). *See* Ex. 41. Circulars 3, 4, 5, and 6 applied to uranium mining on the Colorado Plateau, a geographic area encompassing some 140,000 square miles in Arizona, Utah, Colorado, and New Mexico. Ex. 1002; Doc. 159 at 7. Circular 3 guaranteed, for three years, a minimum price and "development allowance" of fifty cents per pound for uranium ore of .15% grade or more. Ex. 41 at 3-4; *see also id.* at 8-9 (Circular 5 Revised). Circular 4 established a haulage allowance of six cents per mile for the first 100 miles. *Id.* at 5. Circular 5 also guaranteed a minimum price and expanded the development allowance to ore with uranium concentrations as low as .10%. *Id.* at 6. Circular 6 created an additional bonus for the production of uranium ore from new domestic mines. *Id.* at 13-14.

The AEC assisted the young domestic uranium industry by conducting geologic surveys, furnishing free testing and assaying services, and agreeing to purchase uranium ore. Ex. 25 at 13. The AEC established ore-buying stations in uranium-producing areas. *Id.* The AEC's assistance programs included research and development that led to improvement in milling processes and other mining-related innovations. *Id.*; *see also* Chenoweth Depo. Jan. 15, 2014, at 85.[4]

Beginning in 1948, the AEC, assisted by the USGS, operated a program of uranium exploration on the Colorado Plateau and several other western states. Ex. 25 at 14. The program involved temporary withdrawal of some 700 square miles of public domain land for exploration, geologic studies, drilling, examination of samples, and airborne reconnaissance. *Id.* The AEC employed a contractor, Walker Lybarger, to use a bulldozer to uncover any uranium outcrops that were discovered. Chenoweth Depo. Jan. 15, 2014, at 103.[5] Ore found on AEC land was leased to private parties directly through the AEC in return for a royalty on ore production. Ex. 25 at 14; *see also* Chenoweth Depo. Jan. 15,

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[4] The relevancy and Rule 403 objections to this deposition testimony are overruled. When the Court relies on any other deposition testimony submitted by the parties to which an objection has been made, the Court will state its ruling in this order.

[5] The Rule 403, 602, and 802 objections to this deposition testimony are overruled.

2014, at 79-82. The AEC also undertook an access road program under which the AEC, the Bureau of Public Roads, and various state agencies improved over 1,200 miles of roads in Arizona and other states to facilitate uranium exploration and mine development. Ex. 25 at 15.

In July 1952, Charles Steen, an independent prospector, found uranium on the Colorado Plateau south of Moab, Utah. *See* Tr. at 56-57, 1600. Steen made over a million dollars on the ore deposit, and his success motivated many others to pursue uranium mining, launching a gold-rush-like interest in prospecting for uranium. Tr. at 57.

C. Uranium Mining on the Navajo Reservation.

Because the 19 Mine Sites are all located on the Navajo Reservation, both the Navajo Nation and the federal government were involved in transactions affecting the sites. Generally, four permits or leases are required for uranium mining: (1) prospecting permits, (2) drilling and exploration permits, (3) mining permits, and (4) mining leases. *See* Ex. 31 at 10. As of 1951, the Navajo Nation did not require a separate drilling and exploration permit (Ex. 1075) and required only non-Navajos to apply for prospecting permits (Ex. 31 at 10). In 1953, the Nation's mining regulations were updated to require drilling and exploration permits. Ex. 1078. The new regulations also required any prospector, Navajo or non-Navajo, to apply for a prospecting permit. *Id.* at 2. A non-Navajo permit holder could negotiate a mining lease with a tribal advisory committee. *Id.*

Permits were approved by the Navajo Tribal Council and the area director of the BIA. *See* Tr. at 160-61; *see, e.g.*, Ex. 294A. All rents and royalties were paid to the United States Treasury for deposit exclusively in Navajo tribal funds. *See* Tr. at 203, 523. The permits contained provisions related to the trust oversight responsibilities of the DOI and required permittees to (1) "conform to any and all regulations of the Secretary of the Interior"; (2) receive approval from the Tribal Council and the Secretary of the Interior before assigning the permit; and (3) allow inspection of permitted premises and operations by BIA personnel. Ex. 294A at 3-4. These provisions and the DOI oversight of the leases were consistent with the DOI's trust duties over all reservation mining. *See* Tr. at 162-63, 90 (the lease authorization requirement is consistent with all mining contracts on the Navajo reservation); Ex. 75 (example of a lease rejected by the BIA consistent with its tribal trust duty); Ex. 13 (delegating approval of leases to the Secretary of the Interior because it was in a better position to make profitable lease arrangements for tribes); *see also Navajo Tribe of Indians v. United States*, 9 Ct. Cl. 227, 232 (1985) (noting that the United States has a responsibility to supervise the affairs of Indian tribes). The Navajo Nation exercised independent decision-making authority and had a strong interest in developing uranium resources on tribal lands, and that the United States supported the Nation's efforts consistent with its role as tribal trustee. Tr. at 893-95, 899-904, 941-42, 988-89.

D. The Mine Sites.

In 1952, Charles Huskon, a Navajo prospector who worked for AEC contractor Walker Lybarger, discovered a natural uranium outcrop that would later become Huskon 1. Ex. 28 at 6. In July 1952, Huskon and his son left the contractor to work for Arrowhead. *Id.* In August and September, 1952, Huskon received mining permits for Huskon 1, 2, 3, 4, 5, 6, 7, and 8, and assigned them to Arrowhead. Ex. 294D. In Apr. 1953, the BIA approved a mining permit for Huskon 9, 10, and 11, which Huskon also assigned to Arrowhead. Ex. 24 at 53. Huskon 12, 14, and 17 were surveyed and located in December 1953 and January 1954 (Tr. at 525-27; Ex. 1023), but permits were not obtained until March 1954 (Ex. 294D).

Rare Metals acquired Arrowhead in December 1954 and took over all of its uranium mining operations. *See* Exs. 1040-44. In 1955, mining permits for Ramco 20, 21, and 22 were issued to Navajo prospectors and assigned to Rare Metals. Ex. 294D. These sites were converted to mining leases in 1959. *Id.* Ramco 24 was permitted by a Navajo prospector in 1957 and assigned to Rare Metals. *Id.*

In 1959, Rare Metals allowed Cameron Mining Company, an independent contractor, to perform mining operations at sites where Rare Metals had ceased operations. Doc. 159 at 8; Tr. at 499-500. These included Huskon 1, 2, 3, 6, 10, 11, 12, and 17, and

Ramco 20, 21, and 22. Exs. 28 at 13; 1165; 1166; Prince Depo. Oct. 9, 1996, at 88-89. Rare Metals relinquished its rights to Ramco 24 in 1958, and its rights to the remaining Mine Sites during the first half of the 1960s. *See* Ex. 294D.

E. Three Mining Phases.

At trial and in their briefs, the parties focused on three phases of mine operations: exploration, mining, and reclamation. The Court makes the following findings of fact with respect to each phase.

1. Exploration.

During exploration, an ore deposit is located through prospecting, confirmed, and uncovered to determine its "dimension, grade, and continuity." Tr. at 216. Common exploration methods in the 1950s included drilling and rim stripping. Tr. at 282. El Paso concedes that there is no evidence the United States ever conducted exploration activities at the Ramco sites (Tr. at 62), and El Paso does not seek contribution for exploratory drilling that occurred at any of the Huskon mines (Tr. at 17). During trial, El Paso also stated that it would assume responsibility for all exploration activities at Huskon 5, 6, and 9. Tr. at 348-49. This order, therefore, focuses on exploration at Huskon 1, 2, 3, 4, 7, 8, 10, 11, 12, 14, and 17. El Paso claims that the United States engaged in rim stripping at each of these sites. The United States disagrees.

Rim stripping occurs when a bulldozer excavates soil, referred to as "overburden," from the top of an ore deposit to expose the mineralized zone. *See* Tr. at 350. During a 45-day period between December 19, 1953 and February 3, 1954, the AEC conducted rim stripping in the Cameron area. Exs. 58; 91 at 2; 129 at 20; 1258. According to a report prepared in 1955 by David Hinckley, an AEC geologist (the "Hinckley Report"), the AEC stripped approximately 45,000 linear feet of soil in the Cameron area during this 45-day window, exposing portions of 15 uranium outcrops. Ex. 129 at 20.

Exploratory trenches made during rim stripping can still be seen at many of the Mine Sites today. Some of the trenches are visible in aerial photographs of the sites taken in

1954, and even more are apparent in aerial photographs taken in 1992. The question is who made the trenches.

AEC and its contractors used a Caterpillar D7 bulldozer for rim stripping – an 11-ton machine that cut a 29-foot-wide swath with its front blade. *See* Tr. at 330-31; Ex. 129 at 20. Arrowhead did not own a machine of this size, but instead used a much smaller Allis Chalmers HD5 front-end loader for work at the Mine Sites. *See* Tr. at 320-22, 441; *see also* Maloney Depo. at 117. After it purchased Arrowhead in December 1954, Rare Metals also used D7 bulldozers, as well as larger D8s, for work at the Huskon Mine Sites. *See* Tr. at 542, 551 (Mr. Beahm testifying that there is no dispute that Rare Metals bulldozers were used at the Huskon mines), 1306 (1992 aerial photos suggest that more rim stripping occurred after 1954); Exs. 130 at 6; 1160 (1957 contract with Rare Metals for contractor stripping of overburden); *see also* Chenoweth Depo. Apr. 24, 2014, at 26 (more exploration by private parties after 1956 than by the AEC before 1956).

El Paso's mining expert, Douglas Beahm, reviewed historical documents regarding the DUPP and historical aerial photographs. Tr. at 311. He visited the Mine Sites six times. *Id.* On the basis of his investigation, Mr. Beahm testified that the AEC performed rim stripping at Huskon 1-12, 14, and 17. Tr. at 349.[6] He testified to measuring a total of 30.2 acres (or 45,362 linear feet) of exploration disturbance at these Huskon sites. Tr. at 358-59. He noted that trenches he observed generally were 29-feet wide, corresponding to the size of a D7 blade, and that his estimated 45,362 linear feet of trenching aligns with the 45,000 linear feet of AEC rim stripping described in the 1955 Hinckley Report – rim stripping performed by the AEC during the 45-day window in 1953 and 1954. Tr. at 358; *see also* Ex. 129 at 20. Mr. Beahm concludes that all of the AEC's rim stripping in the Cameron area was performed at the Huskon Mine Sites, and constitutes the only rim stripping that occurred at those sites. El Paso also presented an undated internal corporate

[6] Mr. Beahm also noted a disturbance at Huskon 26, but he combined Huskon 26 with Huskon 11. *See* Tr. at 349. Thus, Mr. Beahm's numbers are applicable to all 15 Huskon sites.

memorandum which stated that the AEC bulldozed trenches on Huskon 1-11, 12, 14, and 17, and that the company did "[l]ittle bulldozer work . . . except to strip off overburden." Ex. 119; *see also* Tr. at 366-67.[7]

If Mr. Beahm is correct in his conclusion that some 45,000 feet of trenching was done by the AEC at the Mines Sites during the 45-day period described by Hinkley, the trenching would have occurred before the 1954 aerial photos were taken in February 1954 and presumably would be visible in those photos. But the government's aerial photography expert, Mary Sitton, testified that only 13,589 linear feet of rim stripping can be seen within the Mine Sites' boundaries in the 1954 aerial photographs, with approximately 3,000 linear feet outside of the boundaries. *See* Tr. at 1116.[8] She identified many trenches visible at the sites today that cannot be seen in the 1954 aerial photographs. She also noted that the 1955 Hinckley Report attributes the 45,000 linear feet of rim stripping not to the Mine Sites specifically, but to the general Cameron area, which includes scores of mine sites, and that Rare Metals had heavy bulldozers at the Mine Sites in early 1955 and thereafter – machines capable of creating the trenches observed on the ground today. This evidence persuasively suggests that the trenches at Huskon 1-12, 14, and 17 were not all made by the AEC during a single 45-day period in late 1953 and early 1954.

The Court finds Ms. Sitton's testimony about the aerial photographs to be more credible than Mr. Beahm's. She has significantly more aerial photography training and expertise than he does, and she obtained aerial photographs from the National Archives and Records Administration, the USGS, and the University of Arizona. Tr. at 1075. Unlike Mr. Beahm, she reviewed the historical aerial photos through a stereoscope, which allowed her to examine them in 3D. Tr. at 1076. The Court does not find credible Mr. Beahm's

[7] El Paso presented evidence of some AEC involvement and reconnaissance in the Cameron area that predates Arrowhead's mining permits, but it does not specifically refer to rim stripping. *See* Ex. 179 (sampling at Huskon 1 on September 9, 1952, three weeks before Arrowhead received its permit).

[8] Mr. Beahm's exploration numbers included several areas outside of the mine boundaries. *See* Tr. at 617-18. According to El Paso, the EPA specifically requested that it examine these locations, but El Paso has not agreed to do any further remediation there. Tr. 438-41.

assertion that virtually all of the trenches seen on the ground today were present in 1954 but do not appear in the 1954 aerial photographs because they were obscured by shadows or lack of contrast.

The evidence also shows that Arrowhead conducted rim stripping. Mr. Beahm testified that Arrowhead was unable to rim strip by bulldozer because it owned only the HD5 front-end loader, which was incapable of creating the wide trenches observed at the 19 Mine Sites. *See* Tr. at 320-22, 441; *see also* Maloney Depo. at 117. And records do indicate that Arrowhead was primarily a hand-digging operation before it was acquired by Rare Metals. *See* Tr. at 323. Further, Dozing with an HD5 front-end loader would require multiple passes to create a trench as wide as a D7's, would create several separate waste piles, and would not create uniform windrows as observed on the side of trenches at the Mine Sites.[9] But the United States presented evidence that Arrowhead did conduct rim stripping with its HD5 at some of the Mine Sites. Arrowhead cofounder George Morehouse stated that he would "strip down with the dozer, actually [he would use] the front end loader as a dozer." *See* Ex. 69 at 9; *see also* Tr. at 1196-97. Expense and production reports for the Huskon sites, before the 45-day AEC exploration window, also indicate that rim stripping was performed by Arrowhead at the Huskon sites. *See* Ex. 1139 (report for Huskon 1 for October 24, 1952 to March 31, 1953, stating cubic yards for stripping); 1106 at 6 (indicating that overburden was stripped by an ACD5, which is the Allis Chalmers HD5 dozer); *see also* Tr. at 1199.

Based on all the evidence, the Court makes several findings regarding the parties' involvement in the exploration phase.

First, El Paso was directly involved in exploration. It has assumed responsibility for all exploration activities at the Ramco sites and Huskon 5, 6, and 9, as well as all exploratory drilling. The evidence described above shows that Arrowhead engaged in rim

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[9] A windrow is waste material left on either side of a trench dug by a bulldozer, or on one side if the bulldozer's blade is angled. Tr. 332.

stripping, and Arrowhead had mining permits at Huskon 1-11 before February 1954. *See* Ex. 294D. The parties agree that Arrowhead had the authority to mine or explore as a result of those permits. *See* Tr. at 1623. In fact, Arrowhead delivered its first uranium ore shipment from Huskon 1 in October 1952, well before the 45-day window when the United States conducted rim stripping activities in the Cameron area. *See* Ex. 28 at 7-8. The Court finds it likely that the rim stripping at Huskon 1-11 was conducted by Arrowhead in conjunction with its mining activities. *See* Tr. at 1099 (noting that exploration and mining occurred at the same time), 1228 (stripping is done at the mines after mining started).[10]

Second, the Court finds by a preponderance of the evidence that the United States engaged in exploration activities at Huskon 12, 14, and 17. Arrowhead did not receive a permit to mine these sites until March 1954, and yet Ms. Sitton and Mr. Beahm each found disturbances on these sites in the 1954 aerial photos that predate the permits. *See* Ex. 294D. For Huskon 14 and 17, Ms. Sitton noted several linear excavations on the 1954 aerials. *See* Exs. 1354; 1356.

El Paso asserts that Arrowhead could not have created these disturbances without a mining permit. *See* Tr. at 1623. Prior to approval of the survey of the mining claims, Arrowhead had no privileges at Huskon 12, 14, and 17. *See* Tr. at 369. El Paso argues that the United States did have permission from the Navajo Nation to prospect and explore on the lands in question before the February 1954 aerials were taken. Tr. at 341-43; Exs. 58; 1258. The United States appears to argue that because Arrowhead had a prospecting permit, and because it surveyed and plotted Huskon 12, 14, and 17 in December of 1953

[10] It is also possible that some exploration activities at Huskon 1-11 were conducted by the United States. The AEC certainly conducted rim stripping in the Cameron area, at least in the vicinity of the Mine Sites. *See* Exs. 91; 129 at 20. But the Court is not certain how much, if any, occurred on Huskon 1-11. El Paso's only historical document linking AEC exploration to Huskon 1-11 is the undated internal memo that does not identify the source of its information. *See* Ex. 119. And even if the United States conducted additional rim stripping at these sites, it would not affect the Court's allocation. The exploration phase of this case is small compared to the mining phase, and El Paso would, in any event, have welcomed and encouraged AEC rim stripping for more ore at its Mine Sites.

and January 1954, Arrowhead had authority to conduct exploration activities on those Sites. *See* Tr. at 1621. The United States asserts that because the Navajo Nation did not utilize exploration and drilling permits at the time, the prospecting permit gave Arrowhead authority to conduct these exploration activities. *See* Tr. at 1623. Further, the United States argues that the minimal level of activity identified by Ms. Sitton would be consistent with staking a mine claim. Tr. at 1622.

As already noted, the Navajo Nation initially did not require exploration or drilling permits. Tr. at 896, 1255; Exs. 1075; 1078. Miners applied for a prospecting permit and then for a mining permit. Ex. 1075. In December 1953, the Nation updated its regulations, requiring miners to seek first a prospecting permit, then an exploration permit, and then a mining permit. Tr. at 896; Ex. 1078. Mr. Beahm testified that the mining permit was necessary for miners to conduct exploration activities like those seen clearly at Huskon 14 and 17, and that likely occurred at Huskon 12 (Tr. at 117), and the United States failed to present any testimony that supports its theory that a prospecting permit prior to 1953 would allow Arrowhead to conduct exploration.[11] Moreover, the fact that the disturbances in question were labeled as linear excavations or seemed to be made by heavy equipment indicates that these disturbances were not made in the normal course of staking a claim. *See* Trial Tr at 1176 (only use a simple compass and steel chain for staking claims). Because the trenches and disturbances at Huskon 12, 14, and 17 were made at a time when Arrowhead likely did not have authority to do the work, and were made by heavy equipment of the kind operated by the AEC contractor, the Court finds by a preponderance of the evidence that the United States conducted rim stripping at these sites.

Third, the Court does not find, as El Paso suggests, that the AEC conducted most of the exploration activities at the Mine Sites. Mr. Beahm relied heavily on current site visits where he assumed that bulldozer-sized trenches visible on the ground were made by the

[11] United States witness Jay Brigham testified that an individual with a prospecting permit would have an interest in the particular area. *See* Tr. at 944. But that does not mean that the individual would have had the authority to conduct exploration activities or to exclude the United States from conducting exploration activities.

AEC during the 45-day window in late 1953 and early 1954. But this view disregards the fact that the disturbances could have been made at any time during the years of mining by El Paso, including after 1954 when Rare Metals brought its own D7 and D8 bulldozers to the Mine Sites. *See* Tr. at 390; Ex. 1158. Mr. Beahm also relied on historical documents noting that the AEC conducted rim stripping in the Cameron area, but these documents refer to the entire Cameron area, which contained approximately 100 mines. Tr. at 1147 (Ms. Sitton testifying that she noted other activity in the Cameron area), 1112-14 (discussing mapping anomalies that included linear excavations in the Cameron area outside the Mine Sites), 1114-15 (Ms. Sitton testifying that the 45,000 linear feet does not cover just the 19 Mine Sites); *see also* Ex. 1363. And Mr. Beahm's assertion that he measured approximately 45,000 linear feet of trenching, which matched the Hinckley Report on AEC activity, is less credible than Ms. Sitton's testimony that most of this trenching does not appear in the 1954 aerial photographs.

In summary, although the Court finds that both El Paso and the United States engaged in exploration activities at the Mine Sites, the Court does not find that all or even a majority of it was performed by the United States. The evidence does not enable the Court to precisely determine the parties' respective exploration activities at the sites, but this is not an impediment to an overall allocation because the exploration phase is a relatively minor portion of the relevant activity in this case.

2. Mining.

All of the Mine Sites were open pit mines. Tr. at 1611. They were mined either by El Paso or one of the orphan companies. The United States never mined or supervised mining operations at any of the sites. *See* Tr. at 908, 1580; Ex. 69 at 4-5; Chenoweth Depo. Jan. 16, 2014, at 409; Chenoweth Depo. Apr. 24, 2014, at 23, 57.[12]

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[12] An orphan under CERCLA is a "party otherwise qualifying as a responsible party [but who] may be defunct, bankrupt, uninsured, or otherwise lack the resources to bear its ideal measure of responsibility in monetary terms." *United States v Kramer*, 953 F. Supp. 592, 595 (D.N.J. 1997). There were five entities that operated the Mine Sites and eventually went bankrupt: Utco Uranium, Cameron Mining, B.C. Associates, Domino Company, and H.R. Rodgers. *See* Tr. at 743.

The Navajo Nation managed uranium mining on the reservation. Tr. at 941-42; Chenoweth Depo. Jan. 16, 2014, at 408-09. The Nation wrote its own regulations, established a department of mining, conducted mining inspections, and hired a mining engineer. Tr. 893-95; Exs. 31 at 8; 62; 1074; 1080. The United States did conduct inspections through the DOI and the Bureau of Mines ("BOM") to promote mine safety and identify hazards. *See, e.g.*, Exs. 1189-1202; 1207-08; Chenoweth Depo. Jan. 16, 2014, at 409.

Initially, Arrowhead mined with picks, shovels, wheel barrows, the HD5 loader, and a crew of about twelve workers. *See* Ex. 69 at 10. El Paso's proposed findings of fact admit that Arrowhead produced almost 4,000 tons of ore in 1953 and more than 8,000 tons in 1954. *See* Doc. 158 ¶ 167. When Rare Metals acquired Arrowhead in December 1954, production at the mines increased significantly. *See* Doc. 158 ¶ 167; Ex. 1334. In 1956, Rare Metals Mines produced nearly 30,000 tons of ore. *See* Doc. 158 ¶ 167. In 1957, the Mines Sites produced over 40,000 tons. Doc. 158 ¶ 167. As of March 1956, an internal company memo stated that Rare Metals had stripped 291,169 tons of native material at the Huskon sites and another 273,857 tons of overburden at the Ramco sites. Ex. 1135.

Open pit mines are created by stripping away large amounts of overburden and then removing the ore to an onsite stockpile. *See* Exs. 1190-1210 (safety inspection reports documenting mining methods). El Paso's excavations at the Mine Sites ranged in size from shallow trenches to large pits up to 2,400 feet long. Exs. 28 at 5; 1190-1210; *see also* Tr. at 1202. Mine development also included roadbuilding. *See* Exs. 1336 (summarizing miles of road built at each site based on El Paso expense and production reports); 1389 ¶ 17. A majority of the Cameron area waste-generating activity occurred between 1954 and 1961. *See* Exs. 28 at 19; 1334.

El Paso disposed of hazardous substances at each of the Mine Sites. *See* Doc. 117 ¶ 3. The United States did not direct waste handling or waste disposal. *See* Tr. at 907, 921, 1204; Chenoweth Depo. Jan. 16, 2014, at 410. During mining, workers used a Geiger counter to asses wheelbarrow loads of ore and, if a load did not "measure so much on the

Geiger counter, they'd dump it over the hill [] someplace." Chenoweth Depo. Jan. 16, 2014, at 410-11. Waste rock was dumped out of the way so it would not interfere with mining. Chenoweth Depo. Jan. 16, 2014, at 411; *see also* Ex. 69 at 10 (Arrowhead put waste wherever it was convenient).

The AEC bought uranium at the prices and bonuses set by the Circulars. Because miners could grade their uranium on an average monthly basis, they had an incentive to stockpile lower-grade ore and blend it with higher-grade ore to sell to the AEC. Chenoweth Depo. Apr. 24, 2014, at 36. This was a common practice. *See* Tr. at 1610; Ex. 15 at 3; Chenoweth Depo. Apr. 24, 2014, at 36-37.

When El Paso opened the Tuba City mill in 1956, it set an ore grade cut-off of .20% because that was more efficient for the mill's operation. Ex. 280; Chenoweth Depo. Apr. 24, 2014, at 163-64 (the ore grade cut-off was up to the mill, if the mill did not want to take the lower grade the AEC did not force them); *see also* Exs. 1231-32 (mining companies complaining that El Paso was not purchasing lower grade ore as permitted by the Circulars). Even before the mill changed the cut-off, miners were more focused on higher-grade uranium because it sold for a higher price. Chenoweth Depo. Apr. 24, 2014, at 37 (most miners could not make money at the .10% cut-off, so during the uranium boom the average grade was about .23%).

By late 1957, dramatic increases in reported uranium ore reserves and in milling capacity prompted the AEC to announce that "it no longer [was] in the interest of the Government to expand production of uranium concentrate." Ex. 25 at 12. The AEC announced that it would buy "only appropriate quantities of concentrate derived from ore reserves developed prior to November 24, 1958." *Id.* In 1958, the AEC announced that "domestic producers of uranium ores and concentrate" could start making private sales for the peaceful use of atomic energy, but no such sales were actually made until 1966. *Id.*

In 1962, the AEC implemented a "stretch-out" program which allowed mining companies to defer delivery of a portion of their contract commitments until 1967 and 1968, in return for an AEC commitment to purchase the ore in 1969 and 1970. *Id.*

Operations at the Mine Sites phased down as incentives decreased, but there is also evidence that ore reserves at the Mine Sites were exhausted by this time and no longer held enough economically viable uranium. Chenoweth Depo. Jan. 16, 2014, at 410-14 (describing the process of using the Geiger counter to measure uranium from a mine; once it was very low, mining would stop); *see also* Ex. 31 at 7 ("[A]s the known orebodies were depleted, ore production declined sharply after 1958.").

At the end of a mining lease, there was an inspection to ensure that sites were free from physical hazards. *See* Tr. at 154; Ex. 1214; *see also* Chenoweth Depo. Apr. 24, 2014, at 182. Open pits were left unfilled. *See* Prince Depo. Oct. 9, 1996, at 131. Language in the leases and the customs of the day were to leave mines "timbered," which meant leaving the ore body accessible and, in the case of open pit mines, leaving the pit open. *See* Tr. at 154, 1613 (timbered means the structural integrity of the pit walls).[13]

Language in the mine leases also stated that mines were to be surrendered and returned in good condition except for ordinary wear and tear. *See* Tr. at 1576. El Paso's expert, Mr. Dempsey, testified that this provision did not affect the expectation that mine pits would be left open. *See* Tr. at 1577; *see also* Prince Depo. Oct. 9, 1996, at 114. By 1962, El Paso and its subcontractors stopped all mining at the 19 Mine Sites. Prince Depo. Oct. 9, 1996, at 68-69.

3. Reclamation.

For almost three decades, the Mine Sites remained largely in the same condition as when mining ceased, with open pits and waste piles on the properties. In the 1980s, the Navajo Nation became concerned about possible health impacts of abandoned uranium mines on the Reservation. Ex. 1275; Prince Depo. Oct. 30, 1996, at 220-21. People were frequenting the pits for recreational purposes, and livestock was watering at the pits. Prince Depo. Oct. 30, 1996, at 221-22. As a result, in the early 1990s the Navajo Nation undertook

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[13] There is evidence that the Navajo Nation wanted mines closed after 1959 (Ex. 1274), but also some suggestion that this applied only to underground mines (Tr. 156).

reclamation of 17 of the 19 Mine Sites. Reclamation was not deemed necessary at Huskon 5 and 14. Doc. 159 at 9.

Funding for the reclamation was provided through grants from the federal government's Office of Surface Mining ("OSM") under the Surface Mining Control and Reclamation Act ("SMCRA"). Doc. 159 at 9. The Nation's office of Navajo Abandoned Mine Lands ("NAML") developed the plans for reclaiming the mines and submitted grant applications to the OSM. Martinez Depo. at 20-21. The OSM reviewed the applications prior to approving funding. *See id*. The OSM was deferential to the Nation in its review and oversight of the reclamation because of the Nation's status as a sovereign nation. Sassaman Depo. at 126-31. The OSM's role was to oversee the sites for compliance with the NAML plans and to offer advice when necessary. Martinez Depo. 34-36, 40-43; Sassaman Depo. 33-35, 106. All reclamation standards were established by the NAML. Martinez Depo. at 34-35; Sassaman Depo. at 29-30, 35, 56, 74-76.

Through five reclamation projects, the NAML (1) restored hundreds of acres of land, (2) backfilled and graded seventeen uranium mine pits formerly operated by El Paso, (3) removed or reduced the slopes of thousands of feet of dangerous highwalls and embankments, (4) contained mining waste underground to prevent erosion and reduce surface exposure, (5) built drainages structures to divert runoff from the pits and waste piles, (6) removed ponds of polluted water that were sometimes used for recreational and agricultural purposes, and (7) provided replacement ponds for livestock and wildlife. *See* Exs. 1279-85 (NAML technical specifications); 1310 (Project three update report); Prince Depo. Oct. 30, 1996, at 261-62. The United States provided the Nation with $2.4 million in funding for this work. *See* Exs. 1294-1308 (total costs by each site).

F. The Tuba City Mill.

The Tuba City uranium mill was built and operated by El Paso, and purchased ore from Cameron-area mines, including the Mine Sites. The mill is not part of the EPA's current CERCLA directive to El Paso, and the parties disagree on whether its remediation is relevant to the Court's equitable allocation for the 19 Mine Sites at issue in this case.

Originally, Arrowhead and Rare Metals shipped ore to the AEC's Bluewater mill in New Mexico. Exs. 1222; 1162; 1163; 1243. In 1954, Rare Metals contacted the AEC about establishing a mill in the vicinity of the Mine Sites, which would significantly reduce haulage costs. Tr. at 1008; Ex. 107. Rare Metals and the AEC agreed that the AEC would operate an ore-buying station in Tuba City until Rare Metals could finish building the mill, and Rare Metals would then take over the ore-buying function. Exs. 1030 at 5; 1222; 1224. In July 1956, Rare Metals completed construction of the mill and began purchasing ore from mines in the area. Exs. 1241; 1235. The mill operated from 1956 to 1966 and produced 80,000 tons of yellow cake uranium for the United States. Ex. 1072 at 25.

In the Circulars, the AEC offered to purchase uranium ore above a .10% grade. The Tuba City mill adopted a stricter standard, requiring a grade of .20% on a monthly average basis. Exs. 131; 280; 1040; 1226 at 2.

The Tuba City mill generated its own waste pile in the form of "tailings," which consisted of low-level radioactive sand generated from processing uranium ore. Ex. 1317 at 8; Prince Depo. Dec. 1, 2016, at 43-44. El Paso also disposed of liquid wastes from ore processing in an impoundment pond constructed near the mill. Exs. 1317 at 101; 1319 at 5. These operations contaminated groundwater at the site. Tr. at 1262.

El Paso stopped operation of the Tuba City mill in 1966 because uranium sources in the area were exhausted. *See* Ex. 1240 at 2. The Arizona Atomic Energy Commission ("Arizona AEC") oversaw the termination of El Paso's mill license. El Paso was required to stabilize the tailings pile (Ex. 1242), and consulted with the federal BOM to develop a stabilization plan (Ex. 176; Caulkins Depo. at 20-22).[14] El Paso's plan was submitted to and approved by the Arizona AEC, the United States Public Health Service, and the Navajo Minerals Resource Office. *See* Ex. 173. El Paso implemented the plan, and the Arizona AEC terminated El Paso's license, acknowledging that El Paso "effectively decontaminated the mill building," "stabilized the tailings pile against wind erosion," and "fenced and posted the tailings pile." Ex. 177; *see also* Tr. at 1252; Ex. 176.

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[14] The Rule 401 and 403 objections to this testimony are overruled.

Eventually, the United States remediated the mill site under the Uranium Mill Tailings Radiation Control Act ("UMTRCA"). Ex. 1317 at 5, 18-20; 42 U.S.C. § 7901(a). In UMTRCA, Congress acknowledged that uranium tailings at active and inactive mill sites may pose a significant radiation health hazard to the public. *See* § 7901(a). UMTRCA was designed to "stabilize and control [mill] tailings in a safe and environmentally sound manner and to minimize or eliminate radiation hazards to the public." § 7901(b). In effect, the federal government assumed responsibility for the clean-up of uranium-producing mills for the good of the country. Tr. at 1243. Where clean-up occurs on Indian lands, as at the Tuba City mill, the government pays all costs. Ex. 1317 at 9.

The Tuba City mill remediation occurred in two phases from January 1985 to Apr. 1990. Ex. 1317 at 19. Through the end of 2018, the United States has spent $34,143,000 in surface remedial action costs and $59,426, 656 in groundwater remedial action costs, for a total of more than $93,500,000. *See* Ex. 1321. The monitoring process will continue into perpetuity (Ex. 1320 at 7), with the United States' future response costs projected to reach $37,288,757 (Ex. 1321).

G. The EPA and Remediation of the 19 Mine Sites.

When the EPA identifies an abandoned uranium mine that contains a hazardous substance, it requests that a potentially responsible party ("PRP") conduct a Remedial Site Evaluation ("RSE"). *See* 42 U.S.C. §§ 9606, 9607; 40 C.F.R. § 400.15. The RSE investigates the nature and extent of contamination and associated risks. *See* 40 C.F.R. § 400.20. It includes determining the background levels of radiation due to naturally occurring uranium. Stavinoha Depo. at 64-65. In Cameron, background levels vary dramatically from place to place and even within a particular site. *Id.* at 97. After an RSE, the PRP prepares an Engineering Evaluation/Cost Analysis ("EE/CA"), which evaluates potential response actions. Doc. 159 at 10; Tr. at 641.

In May 2012, the EPA sent El Paso a "general notice" letter identifying El Paso as a PRP for the Mine Sites. Doc. 159 at 8; Stavinoha Depo. at 29. In 2013, El Paso signed an administrative order of consent ("AOC") to perform a "limited" investigation. Ex. 263;

Stavinoha Depo. at 53-54. El Paso agreed to conduct gamma screening to determine the lateral extent of disturbed areas within a portion of the 19 Mine Sites. *See* Ex. 263 at 33-34. El Paso submitted a number of work plans related to background levels and gamma scanning (Tr. at 610), and has not missed a deadline with the EPA (Tr. at 610-11).

In 2017, El Paso agreed to conduct RSEs at Huskon 12 and 14, modifying the original AOC. *See* Tr. at 613. In 2018, El Paso entered a second AOC amendment to perform EE/CAs at Huskon 12 and 14. *See* Tr. at 613-14. El Paso also submitted a draft for a third modification to perform RSEs for the remaining 17 Mine Sites. Tr. at 614. To date, El Paso has performed draft RSEs for Huskon 12 and 14. *See* Ex. 1325. El Paso has also prepared a draft EE/CA for both sites. *See* Ex. 285. The EPA has not yet provided comments on these drafts. *See* Tr. at 630. The EPA has not selected a final remedy for Huskon 12 and 14, and El Paso has not agreed to perform a remedy. Tr. at 666.

H. Costs at Issue in this Order.

For purposes of the actual response costs to be allocated in this order, the parties have agreed to a cut-off date of August 1, 2016. El Paso alleges that it has incurred recoverable response costs at the Mine Sites totaling $1,393,448 through August 2016, and has paid another $502,500 to the United States to reimburse certain EPA response costs. *See* Doc. 159 at 13. The United States does not dispute these amounts and stipulates that they are necessary, recoverable, and consistent with the National Contingency Plan. *Id.* 12-13.[15]

The parties made clear at the final pretrial conference on February 13, 2019, that they are asking the Court not only to allocate these existing response costs, but also to enter a declaratory judgment establishing the allocation between them for purposes of all response costs related to the Mine Sites, including amounts to be incurred in the future. The parties agree that the Court need not address interest amounts due under CERCLA,

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[15] The United States originally sought to recover response costs under § 107 in its counterclaim, but this claim was resolved in a consent decree between the parties. *See* Doc. 66. The consent decree did not resolve the United States' contribution claim under § 113. *Id.*

stating that they can agree on such amounts once the Court sets its allocation. The parties further stipulate that the Court should declare their allocated shares of liability as if all response costs incurred by each party were allocated under § 113(f). Doc. 159 at 13.

II. Liability.

A contribution claim under § 113(f) includes four elements: (1) a release or threatened release of hazardous substances; (2) from a facility as defined by CERCLA § 9601(9); (3) which has caused the plaintiff to incur response costs that are necessary and consistent with the National Contingency Plan; and (4) that the defendant is a PRP under CERCLA § 107(a). 42 U.S.C. § 9607(a); *see also* Doc. 159 at 10-11*; City of Colton v. Am. Promotional Events, Inc.*, 614 F.3d 998, 1002-03 (9th Cir. 2010); *Carson Harbor Village, Ltd. v. Unocal Corp.*, 270 F.3d 863, 870-71 (9th Cir. 2001). The parties do not dispute that the first three elements of § 113(f) liability are satisfied in this case, so the liability question focuses on PRP status. Doc. 159 at 10-13.

There are four types of PRP liability: owners, operators, arrangers, and transporters. 42 U.S.C. § 9607(a). As noted above, El Paso stipulates that it was an operator of the Mine Sites and the Court previously held that the United States is liable as an owner. Docs. 108, 135. El Paso argues that the United States is liable as an operator and arranger during all of the mining phases (Doc. 187 at 1-13), and the United States asserts that El Paso is liable as an arranger (Doc.186 at 2-6).[16]

A. United States' Operator Liability.

CERCLA imposes liability on "any person who at the time of disposal of any hazardous substance . . . operated any facility at which such hazardous substances were disposed of." 42 U.S.C. § 9607(a)(2). The word "operated" suggests that the liable party

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[16] The United States further argues that El Paso is liable as an owner because it owned equipment at the Mines Sites and disposed of mining waste with that equipment. *See* Doc. 157 ¶ 71. CERCLA broadly defines "owner" to include an owner of a "facility," and defines "facility" to include "equipment." 42 U.S.C. §§ 9601(9), 9601(20)(A)(ii). But case law is sparse on whether CERCLA liability can be premised on ownership of equipment at a superfund site. The Court need not wrestle with this question, however, because El Paso already is liable as an operator and, in the Court's view of the equities, adding equipment-owner liability would not change El Paso's equitable allocation.

actually took some action with respect to the facility. The Supreme Court has agreed, holding that "an operator must *manage*, *direct* or *conduct* operations specifically related to pollution[.]" *United States v. Bestfoods*, 524 U.S. 51, 66-67 (1998) (emphasis added). The Ninth Circuit similarly has held that an operator must play an "active role in running the facility, typically involving hands-on, day to day participation in the facility's management." *Long Beach Unified Sch. Dist. v. Dorothy B. Godwin Cal. Living Tr.*, 32 F.3d 1364, 1367 (9th Cir. 1994).

El Paso suggests that operator liability can be imposed on the basis of mere "authority to control" operations at a site, even if that authority is not exercised. Doc. 187 at 2. The Ninth Circuit did state in *Kaiser Aluminum & Chemical Co. v. Catellus Development Corp.*, 976 F.2d 1338 (9th Cir. 1992), that operator liability applies to a party that "had the authority to control the cause of the contamination at the time the hazardous substances were released into the environment." *Id.* at 1341. But *Kaiser* did not hold that unexercised authority is sufficient for operator liability. Rather, it imposed operator liability on a party that actually excavated and graded the contaminated property, spreading hazardous waste. *Id.* at 1339-40. *Kaiser*'s holding that such an actor is liable as an operator comports with the Supreme Court's instruction that operator liability "must be read to contemplate 'operation' as including the *exercise* of direction over the facility's activities." *Bestfoods*, 524 U.S. at 71 (emphasis added). It also squares with the Ninth Circuit's teaching that a party cannot be liable as an operator for merely "stand[ing] by and fail[ing] to prevent the contamination." *Long Beach*, 32 F.3d at 1367.[17]

1. Exploration.

El Paso asserts that the United States directed, managed, or conducted rim stripping at several of the Huskon Mine Sites. *Id.* at 4. As explained above, the Court finds by a preponderance of the evidence that the United States engaged in rim stripping at Huskon

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[17] Judge Winmill harmonized the Ninth Circuit's language in *Kaiser* and *Long Beach* with this definition: "CERCLA operator liability attaches if the defendant had authority to control the cause of the contamination at the time the hazardous substances were released into the environment and actually exercised such control." *Nu-W. Min. Inc. v. United States*, 768 F. Supp. 2d 1082, 1089 (D. Idaho 2011) (citation omitted).

12, 14, and 17. These exploration activities released hazardous substances. *See* Tr. at 316-17, 372, 669, 1186-87. As a result, the United States controlled the "cause of the contamination at the time the hazardous wastes were released into the environment." *Kaiser*, 976 F.3d at 1341. The United States is liable as a CERCLA operator for its role in rim stripping at these three Mine Sites.

2. Mining.

El Paso argues that the United States was an operator during the mining phase because it exercised control over mining operations through its authority over El Paso's permits and leases. The evidence cited by El Paso in support of this proposed liability shows that the United States, through the BIA, approved mining permits and leases, possessed the authority to terminate permits and leases, rejected a lease at least once, retained authority to inspect the Mine Sites, required El Paso to comply with relevant regulations, and retained authority to hear disputes between El Paso and the Navajo Nation. *See* Doc. 187 at 5 (citing testimony and exhibits). But this evidence merely establishes that the United States had some "authority to control" what happened at the Mine Sites, not that the United States actually exercised that authority as required for operator liability, as explained above.

Several historical witnesses who worked at the Mine Sites testified that the United States did not have direct involvement in the mining operations. James Maloney testified that he never saw anyone from the federal government at the Mine Sites. Maloney Depo. at 28. George Morehouse reported that there was no federal oversight of the mining operations. Ex. 69 at 4-5. William Chenoweth testified that the AEC did not review or approve mining plans or supervise mining operations. Chenoweth Depo. Jan. 16, 2014, at 409; Chenoweth Depo. Apr. 24, 2014, at 23, 57.

The Court finds that the United States did not "manage, direct, or conduct operations specifically related to pollution," *Bestfoods*, 524 U.S. at 66-67, and that mere possession of such authority is not enough for operator liability, *Long Beach*, 32 F.3d at 1367. Other cases have reached comparable conclusions. *See Cour D'Alene Tribe v. Asarco Inc.*, 280

F. Supp. 2d 1094, 1128-30 (D. Idaho, 2003) (finding no United States operator liability even where compliance with the government's wartime directives was mandatory); *see also Miami-Dade County v. United States*, 345 F. Supp. 2d 1319, 1344-46 (S.D. Fla. 2004) (holding that the manual detailing contractors' inspection and quality control responsibilities did not amount to direction of waste disposal practices).

El Paso argues that the United States exercised control of the Mine Sites through the AEC and the DUPP by (1) creating the domestic market for uranium ore; (2) exercising authority over the possession, transport, and delivery of the ore; (3) acting as the sole purchaser of the ore; (4) controlling El Paso's profits by controlling ore prices, bonuses, and allowances; and (5) setting the ore-grade cut-off, which determined what level of uranium-bearing materials necessarily would be left at the Mine Sites. Doc. 187 at 6. The Court agrees that the United States influenced the operations of El Paso and other uranium mining companies in the 1950s and 1960s. The DUPP was created to foster development of domestic uranium mines, the AEC actively promoted mining on the Colorado Plateau and in the Cameron area, the government regulated the acquisition and handling of uranium ore and was the sole purchaser of the ore for many years, and the AEC exercised some financial control over the uranium market through the Circulars. But El Paso was not conscripted into the uranium business, and the government did not tell it how to operate its mines or dispose of its waste. El Paso stayed in the business and expanded its operations as long as they were profitable and left the business when they were not. El Paso decided who to hire, how much to pay them, what equipment to use, how much money to invest, where to mine, how to mine, how to dispose of waste, and how long to operate. El Paso excavated the ore, created waste piles, and built the mill that had the effects of increasing the profitability of mining in the Cameron area and promoting the development and expansion of the Mine Sites and other mines. El Paso continued to mine and process uranium at the mill after the United States allowed private party purchases of uranium and announced its stretch-out program, and continued to process ore until the supply was exhausted. *See* Ex. 1240 at 2. Given these facts, the Court cannot conclude that the influence exercised by the United States over uranium mining and markets rose to the level of "manag[ing], direct[ing], or conduct[ing] operations specifically related to pollution," as required for CERCLA operator liability. *Bestfoods*, 524 U.S. at 66-67.

This is true even when the Court considers the most direct influence the government exerted on contamination-creating activities – the Circular's establishment of a .10% grade cut-off. While it is true that this cut-off resulted in less concentrated uranium-bearing materials being left as waste at the sites, some cut-off level was required. El Paso cannot plausibly argue that no cut-off level should have been established – that even the most minute concentrations of uranium in soil or rock should have been purchased and milled on behalf of the government. This fact is best demonstrated by El Paso's own .20% cut-off at the Tuba City mill. This level resulted not only in ore below .10% being left at the Mine Sites, but also in ore below .20% being left there. El Paso's cut-off produced the same on-site contamination as the Circular, and more. The Court cannot conclude that the Circular's cut-off level constituted sufficient managing, directing, or conducting of pollution-creating operations to give rise to operator liability.

Other cases which have considered comparable levels of government influence have reached the same conclusion. *See United States v. Iron Mountain Mines*, 987 F. Supp. 1277, 1285 (E.D. Cal. 1997) ("Despite its creation of various incentives and programs to assist mining companies, the government did not compel Mountain Copper to do any mining at Iron Mountain; it did not require Mountain Copper to extract a certain amount of any substance from Iron Mountain; and it did not issue commands to Mountain Copper as to how, where, or when to mine."); *see also Cour D'Alene Tribe*, 280 F. Supp. 2d at 1129 (finding no operator status where the government lacked managerial control over the mines, the mines and mills were not forced to produce but elected to aid the war effort and participate in the government's premium price plan, the mining companies owned the equipment used in the mines and mills, the government set the price for the metals but did not control who could purchase them, and the mining companies controlled the mechanisms creating the tailings and disposal of the tailings).

The facts of this case are also distinguishable from cases where the United States has been held liable as an operator. For example, in *FMC Corp. v United States Department of Commerce*, 29 F. 3d 833 (3d Cir. 1994), the Third Circuit found the government liable as an operator because it (1) required the facility to manufacture a certain product, (2) controlled the supply and price of the raw materials, (3) supplied equipment for use in the manufacturing process, (4) acted to ensure the facility retained an adequate labor force, (5) participated in the management and supervision of the labor force, (6) had authority to remove workers, and (7) controlled the price of the product and who could purchase the product. *Id.* at 843. In this case, the United States had no oversight of mining or labor activities at the Mine Sites, other than generic safety responsibilities, and did not compel El Paso to mine for uranium. *See* Tr. at 1580; *Coeur D'Alene Tribe*, 280 F. Supp. 2d at 1130 (distinguishing *FMC* where the mining companies maintained actual control over the mines and mills, hired and fired its owner employees, and voluntarily decided to mine for metals and participate in the government's premium plan).

In *Cadillac Fairview/California, Inc. v. Dow Chemical Co.*, 299 F. 3d 1019 (9th Cir. 2002), the government owned the site, the pits, the plant, and all materials, including the wastes, had unfettered control over Dow Chemical's waste producing actions, and made an express agreement to indemnify Dow Chemical. The United States in this case did not exercise similar control and did not indemnify El Paso.

El Paso cites *MRP Properties, LLC v. United States*, 308 F. Supp. 3d 916 (E.D. Mich. 2018), to argue that even the government's passive or unintentional control of the Mine Sites' operations gives rise to operator liability. But *MRP Properties* involved a motion to dismiss for failure to state a claim. The trial court assumed all facts alleged in the complaint to be true and construed them in the plaintiff's favor. *Id.* at 928. Those allegations included an assertion that the United States "controlled day-to-day operations at each refinery." *Id.* The complaint also alleged that the government "oversaw" or "dictated" the "amount and type of wastes generated and released at each refinery and tracked these production loss statistics." *Id.* at 929. In denying the motion to dismiss, the

MRP court noted that further factual development might disprove these allegations, stating that "[a] key factual question in this case is whether and to what extent the Government's alleged control of inputs, outputs, conversion of facility operations, and constructions projects, was specifically brought to bear on operations having to do with leakage or disposal of hazardous waste." *Id.* at 934. This case is different. The Court is making factual findings on a full evidentiary record, not deciding a motion to dismiss. The Court finds that the government did not manage, direct, or conduct disposal of hazardous waste at the Mine Sites, and that El Paso freely chose to enter the uranium mining business and contract with the United States. To the extent language in *MRP* can be read to suggest that the passive possession of authority gives rise to operator liability, the Court finds it inconsistent with the Supreme Court's instruction that such liability "must be read to contemplate 'operation' as including the *exercise* of direction over the facility's activities." *Bestfoods*, 524 U.S. at 71 (emphasis added).

3. Reclamation.

El Paso argues that the United States is liable as an operator during the reclamation phase at the Mine Sites. Doc. 187 at 11. El Paso asserts that federal agencies worked with the Nation to plan and determine a "joint strategy" for reclaiming the sites. *Id.* Further, the United States paid for the reclamation through funding under the SMCRA grant. Once the reclamation strategy was in place, the OSM reviewed and approved the Nation's plans and oversaw the work. *Id.* Specifically, El Paso asserts that the United States approved and oversaw the importation of off-site uranium-bearing material as cover on the reclamation sites. *Id.* at 11-12.

The Court does not agree with El Paso's factual assertions. As discussed above, a division of the Navajo Nation – the NAML – created the reclamation's guiding specifications. *See* Ex. 198; Sassaman Depo. at 29-30, 35, 56, 74-76; Martinez Depo. at 34-35. Once the plans were submitted for the SMCRA grant, the OSM provided oversight to ensure that the plans were being performed pursuant to the grant. *See* Martinez Depo. at 20-21. But management of the day-to-day reclamation activities and handling of all reclamation subcontracts was performed by the Nation. *See* Tr. at 517-18. The OSM employees responsible for overseeing the reclamation testified that their job was to make sure the site existed, ensure that the work followed the Nation's reclamations standards, and give suggestions where appropriate. *See* Martinez Depo. 34-36, 40, 41-43; Sassaman Depo. 33-35, 106. The OSM employees were conscious of the fact that the Navajo Nation was an independent sovereign that should be granted special deference. Sassaman Depo. at 126-31.

El Paso's own expert, Mr. Beahm, acknowledged that the Navajo Nation took the lead on reclamation. The Nation conducted an inventory of the Mine Sites in the 1980s and decided in the early 1990s to reclaim 17 of the 19 sites (Tr. at 511); performed the assessments for the reclamation projects (*id.* at 516); developed the technical specifications for the projects (*id.*); selected the contractors who would do the work (*id.*); and performed the day-to-day management of the projects (*id.* at 517-18).

El Paso argues that various federal government agencies participated in planning the reclamation project. *See* Tr. at 516-17. But this was due to the overlap between the EPA's authority to prioritize hazardous waste sites and the NAML's authority to reclaim sites that present public health hazards. El Paso points to a letter from the EPA to the DOI regarding a meeting among several federal agencies. *See* Ex. 198. But the letter indicates that the NAML should continue to reclaim sites under SMCRA and develop reclamation standards in conjunction with the Navajo Superfund Program ("NSP"). *Id.* Meanwhile, the NSP should continue working with the EPA to identify sites that are not eligible for SMCRA funding. *Id.*; *see also* Ex. 201 (letter stating that the NAML should continue reclamation and SMCRA clean-up will be the most appropriate funding source). Thus, the cooperation identified by El Paso resulted in substantial deference to tribal environmental agencies and does not indicate that the federal government exercised control over reclamation at the Mine Sites. The Court finds that the United States was not a CERCLA operator with respect to reclamation.[18]

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[18] El Paso's citation to *California Department of Toxic Substances Control v. Jim*

B. Arranger Liability.

El Paso argues that the United States was an arranger during all three phases of mining. An arranger is "any person who by contract, agreement, or otherwise arranged for disposal or treatment" of hazardous substances. 42 U.S.C. § 9607(a)(3). The Supreme Court has held that, "[i]n common parlance, the word 'arrange' implies action directed to a specific purpose." *Burlington N. & Santa Fe Ry. Co. v. United States*, 556 U.S. 599, 611 (2009). "Consequently, under the plain language of the statute, an entity may qualify as an arranger . . . when it takes intentional steps to dispose of a hazardous substance." *Id.* Mere knowledge of possible disposal is not enough: "knowledge alone is insufficient to prove that an entity 'planned for' the disposal[.]" *Id.* at 612. A party must act "with the intention" that hazardous waste be disposed in the transaction in which the party is participating. *Id.*

El Paso's argument regarding the government's arranger liability largely overlaps its argument on operator liability. Both are based on essentially the same government activity. As a result, although the two forms of CERCLA liability differ, the Court's ruling on arranger liability largely tracks its ruling on operator liability.

1. Exploration Phase.

El Paso argues that the AEC arranged for its primary contractor to perform rim stripping at the mine sites. Doc. 187 at 5. The Court has already held that the United States is an operator for purposes of the exploration activities at Huskon 12, 14, and 17. The Court concludes that government arranger liability has not been proved for the other Mine Sites, for reasons explained above, and that imposing arranger liability for Huskon 12, 14,

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Dobbas, Inc., No. 2:14-595 WBS EFB, 2014 WL 4627248 (E.D. Cal. Sept. 16, 2014), is not helpful. That case recognized, as this Court does, that whether a government is liable as a CERCLA operator of a facility "depends on whether it managed, directed, or conducted operations there." *Id.* at *3. The district court addressed a motion to dismiss, accepted all allegations as true, construed the allegations in the light most favorable to the claiming party, and held only that a State's issuance of several remedial action plans over a period of years "could plausibly constitute management or direction of operations there." *Id.* The case did not attempt to specify what level of involvement is necessary to trigger CERCLA liability and provides no guidance in this case.

and 17 would not change the Court's equitable allocation in this case. As a result, the Court need not decide whether United States is an arranger for these three sites.

2. Mining Phase.

El Paso argues that the United States was an arranger during the mining phase because of the Circulars' ore grade cut-off level. Doc. 187 at 7. El Paso asserts that this level shows the United States intended mine operators to separate and leave behind low-grade uranium-bearing materials. *Id.* at 8.

The Court agrees that the United States knew low-grade uranium-bearing material would be left at the Mine Sites, although, as noted above, such a result was likely an inevitable result of any mining process. But as the Supreme Court has made clear, knowledge is not enough. The party must "take[] intentional steps to dispose of a hazardous substance." *Burlington*, 556 U.S. at 611.

The evidence does not show that the United States took intentional steps to dispose of waste at the Mine Sites during the mining phase. As already discussed, El Paso decided what equipment to use, where to mine, how to mine, how to dispose of waste, and how long to operate the mines. El Paso excavated the ore at the Mine Sites and created the waste piles. The government's cut-off levels may have influenced what waste was left behind, just as El Paso's higher mill cut-off level did, but such influence does not amount to intentional action to dispose of hazardous materials.

3. Reclamation Phase.

El Paso asserts that federal agencies took a leading role in establishing the reclamation strategy and approving grant applications, reclamation plans, and the comingling of waste from mines operated by third parties. Doc. 187 at 13. According to El Paso, these actions were intentional steps to arrange for the disposal of hazardous substances that resulted from dispersal of waste piles, disturbance of native uranium-bearing material, and the import of uranium-bearing material to the Mine Sites. *Id.*

As explained above, however, the Court does not find that the United States controlled the reclamation work or set the reclamation standards. Its role in reclamation was primarily as the source of reclamation funds. The Court cannot conclude that the United States' general oversight and funding responsibilities amounted to "intentional steps to dispose of a hazardous substance." *Burlington*, 556 U.S. at 611.

4. Broader Arranger Liability.

In *United States v. Shell Oil Co.*, 294 F.3d 1045 (9th Cir. 2002), which predated the Supreme Court's decision in *Burlington*, the Ninth Circuit discussed what it characterized as "broader arranger liability." *Id.* at 1055. The court addressed whether the United States was subject to arranger liability for its actions in the production of aviation gas ("avgas") during World War II.

"Because avgas was critical to the war effort, the United States government exercised significant control over the means of its production during World War II." *Id.* at 1049. The government established several agencies to oversee war-time production; established a nationwide priority ranking system to identify scarce goods, prioritize their use, and facilitate their production; made policy determinations regarding the construction of new facilities and allocation of raw materials; had authority to issue production orders to refineries; entered contracts to ensure avgas production; offered low-cost loans to refineries to help finance the construction of avgas-producing plants; assisted refineries in exchanging and blending various avgas components in order to maximize production; directed that specific component exchanges be made; provided detailed instructions for blending; directed refiners to blend avgas in a way that would allow increased overall production; but did not exercise direct actual control over the production of avgas components. *Id.* at 1049-50. The government knew avgas production generated acid wastes and that increased avgas production increased acid waste generation, but it never specifically ordered or approved the dumping of the spent acid that caused contamination. *Id.* at 1051. In addressing the United States' arranger liability in light of these facts, the Ninth Circuit considered four circuit court decisions.

One of the cases found arranger liability where the party owned hazardous chemicals, arranged for their blending by another company, and knew that the blending process generated and disposed of hazardous waste. *See United States v. Aceto Agric. Chems. Corp.*, 872 F.2d 1373, 1381 (8th Cir.1989). The Ninth Circuit in *Shell Oil* found that *Aceto* was not persuasive because, in the avgas case before it, the United States was the end purchaser of avgas, never owned any of the raw materials or intervening products, and did not contract out a crucial and waste-producing intermediate step in a manufacturing process. 294 F.3d at 1056.

The second case imposed arranger liability on a company whose vice president agreed with a third party to bury drums of chemical waste on a farm several miles from the plant. *See United States v. Ne. Pharm. & Chem. Co.*, 810 F.2d 726 (8th Cir.1986). The Ninth Circuit found the case inapplicable because the United States in its avgas operations "did not exercise any actual control over the Oil Companies' disposal of spent acid and acid sludge[.]" 294 F.3d at 1057.

In the third case, the en banc Eighth Circuit split evenly on the question of whether the United States was an arranger for its World War II involvement in rayon manufacturing. The government vigorously sought to increase production of rayon during the war, installed government-owned rayon-manufacturing equipment at a plant, ensured an adequate supply of sulfuric acid for the plant, built and retained ownership of a new acid plant next door, obtained draft deferments for workers at the plant, directly controlled the process by which the rayon was manufactured, directly controlled the supply of the raw materials, and directly controlled the price of the rayon produced. *See FMC Corp.*, 29 F.3d at 833. The Ninth Circuit observed that "[i]f it was a close question on the facts of *FMC* whether the United States was an arranger, it cannot possibly be a close question on the facts in the case before us." 294 F.3d at 1058.

Finally, *Shell Oil* considered another case where the Eighth Circuit held that the United States was not an arranger in connection with the production of Agent Orange during the Vietnam War. *See United States v. Vertac Chem. Corp.*, 46 F.3d 803 (8th Cir. 1995). The Ninth Circuit found the facts in *Vertac* comparable to the avgas facts before it and concluded that the United States was not an arranger. The court provided this comparison between the avgas and Agent Orange facts:

> In both cases, products were manufactured for purchase by the United States in war-time; in both cases, the manufacturing was carried out under government contracts and pursuant to government programs that gave it priority over other manufacturing; in both cases, the companies voluntarily entered into the contracts and profited from the sale; and in both cases, the United States was aware that waste was being produced, but did not direct the manner in which the companies disposed of it.

294 F.3d at 1059.

These facts – recited from *Shell Oil* and *Vertac* – closely parallel the facts in this case. Uranium ore was mined for purchase by the United States in war-time; the mining was carried out under government-approved permits and leases and pursuant to a government program that sought to encourage domestic uranium production; El Paso voluntarily entered into the mining and profited from both mining and milling; and "the United States was aware that waste was being produced, but did not direct the manner in which the [El Paso] disposed of it." *Id.* The Ninth Circuit held in *Shell Oil* that the United States was not an arranger, a holding which makes clear that the government is not an arranger in this case, even under the "broader arranger theory." *See Coeur D'Alene Tribe*, 280 F. Supp. 2d at 1132 ("The *Shell* [*Oil*] court determined that mere 'authority to control' was insufficient without some actual exercise of control.").[19]

5. El Paso Arranger Liability.

The United States argues that El Paso should be liable as an arranger because it exercised actual control over all aspects of the mining operations, including disposal of

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[19] As part of its argument for arranger liability of the United States, El Paso cites an Arizona case from 1914 and a Ninth Circuit case from 1908 for the proposition that waste rock at the Mine Sites always belonged to the United States because, although it was moved, there was never an intent to sever it from the realty. Doc. 187 at 10. But El Paso does not explain why these cases apply to land on the Navajo Nation Reservation, and the Court notes that at least one more recent case has rejected this legal principle for federal lands. *See Chevron Mining Inc. v. United States*, 863 F.3d 1261, 1283 (10th Cir. 2017) ("The United States neither owned nor possessed the waste rock and tailings extracted from Chevron's molybdenum mining activities."). El Paso's argument does not alter the Court's conclusion that the United States was not a CERCLA arranger during the mining phase.

mining waste at the Mine Sites. *See* Docs. 186 at 3; 157 at 80-82 ¶¶ 62. El Paso has already conceded its operator liability, which encompasses control over waste-generating activities. The Court concludes that imposing arranger liability for the same actions would not change the Court's equitable allocation in this case. As a result, the Court need not decide whether El Paso is an arranger

III. Equitable Allocation.

The Court may allocate response costs among liable parties using such equitable factors as the Court determines are appropriate. 42 U.S.C. § 9613(f)(1). The liability of a responsible person under § 113(f) corresponds to that party's equitable share of the total liability. *Fireman's Funds Ins. v. City of Lodi, Cal.*, 302 F.3d 928, 945 (9th Cir. 2002).

A. El Paso's Proposed Allocation.

El Paso suggests that the Court allocate responsibility for all past and future response costs by (1) creating three categories or buckets, one for exploration, one for mining, and one for reclamation; (2) assigning a percentage of overall site responsibility to each of these three buckets based on the volume of soil moved during each phase; (3) allocating the portion within each bucket between El Paso and the United States; and (4) adding the percentage allocated to each party in each of the three buckets to arrive at the overall allocation. Using this model, El Paso's proposed allocation assigns 86.77% of the liability for the Mine Sites to the United States, and 13.23% to El Paso. The Court disagrees both with the percentage of site responsibility El Paso assigns to each of its proposed buckets and with its suggested allocation within each bucket.

1. El Paso's Percentage Division Among Buckets.

El Paso's three-bucket approach was developed by its allocation expert, David Batson. He allocated a percentage of overall site responsibility to each bucket by adopting Mr. Beahm's estimates of the amount of soil moved during each of the three phases of mining. Tr. at 735-36. The Court finds this approach seriously flawed.

During the exploration phase, Mr. Beahm estimated that 132,000 cubic yards of soil was moved, amounting to about 7% of all soil moved during the exploration, mining, and reclamation phases. Mr. Batson therefore assigned 7% of the overall responsibility for response costs to the exploration bucket. Mr. Beahm reached this 7% calculation by relying on the 45,000 linear feet of trenching he attributes to the 45-day AEC exploration window. As explained above, however, the Court cannot accept Mr. Beahm's conclusion that 45,000 feet of trenching was done at the Mine Sites in late 1953 and early 1954 when it is not shown on the 1954 aerial photographs, nor that all of it was done by the AEC. The Court has little confidence in Mr. Beahm's conclusion about the amount of soil moved during the exploration phase, and therefore in Mr. Batson's assignment of 7% of the overall site responsibility to the first bucket.

The size of the second bucket – 59% of overall site responsibility – is based on Mr. Beahm's calculation of the amount of soil moved and left at the site during the mining phase. He calculated that amount by estimating the volume of the mine pit at each site, subtracting from that volume the amount of ore sold from the site, and increasing the result by 20% to reflect the fact that soil expands after it is removed from the ground. Tr. at 418-19. But this calculation assumes that the only soil El Paso moved at the Mine Sites was the soil that came from within the walls of the pits as they appeared when Mr. Beahm visited the site decades later or in aerial photographs taken before reclamation by the Navajo Nation. The calculation fails to account for soil moved by El Paso at the Mine Sites to excavate overburden down to where the pit mining actually started; to clear ground for mine structures, ore piles, ore blending, and waste piles; to build ramps into and out of mine pits; and to build roads around and into the Mine Sites. *See* Tr. at 1500-01.

The amount assigned by El Paso to the third bucket – 34% – is based on Mr. Beahm's estimate of the amount of new soil moved during reclamation. Mr. Beahm noted that the volume of soil moved during reclamation was higher than his calculated volume for mining. Tr. at 413-17. He subtracted his mining volume from the reclamation volume and arrived at 643,308 cubic yards of soil that he claims was moved for the first time during reclamation. Tr. at 1396. He explains this additional soil movement by assuming that the Nation's reclamation contractors moved more soil than necessary when reclaiming waste piles. Tr. at 420. He asserts that they likely dug into the soft undisturbed dirt when moving the waste piles. Tr. at 477-78. He also notes that soil was brought from off-site to complete the reclamation. Tr. at 479-80. The Court views this reclamation calculation as unreliable because it relies on Mr. Beahm's mining volume, which the Court finds unreliable for reasons stated above. The Court also has difficulty with the implicit assumption that the movement of additional soil in reclamation was unnecessary – that reclamation could have been accomplished by moving no more soil than was originally disturbed during mining. No evidence was presented to support this assumption, and yet it is the basis for the third bucket, which is a percentage of site costs independent of mining and exploration activities that El Paso claims should be assigned to somebody. If the movement of additional soil was a necessary part of reclaiming the Mine Sites, then it could be considered a product of mining and allocated in accordance with the mining allocation. The Court cannot agree that it should be treated as a separate percentage of the overall site costs to be allocated without regard to mining activities, as El Paso proposes.

2. El Paso's Allocation Within Each Bucket.

The Court also disagrees with how El Paso's allocates responsibility within each bucket. The first bucket represents 7% of the overall response cost liability, and El Paso allocates 70% of it to the United States and 30% to itself. This allocation assumes that the AEC did all of the exploration at the 12 Huskon Mine Sites accounted for in this bucket and during the 45-day window. Tr. at 735.[20] As noted above, the Court does not find this position credible. The Court finds that the United States engaged in exploration activities at Huskon 12, 14, and 17, considerably less than all of the exploration activities that occurred at the 12 Huskon Mine Sites in El Paso's proposed first bucket.

For the second bucket – the mining phase – Mr. Batson starts with an allocation of two-thirds liability to the United States as landlord, active owner of the land, and arranger for the disposal of the hazardous substances, and one-third to El Paso as an operator that

[20] Initially, Mr. Batson noted 15 Huskon sites, but he scaled this back to 12 sites, omitting Huskon 5, 6 and 9, the three sites where El Paso decided not to seek contribution for the exploration phase. *See* Tr. at 752.

conducted mining activities. Tr. at 738. From this largely unexplained baseline, Mr. Batson considers the impact of four equitable factors: (1) the benefits received by each party, (2) the degree of knowledge regarding the risks of the contamination, (3) the degree of cooperation by the parties, and (4) the degree of control and care exercised by each party in relation to knowledge. Tr. at 739. Based on these factors, Mr. Batson recommends increasing the United States' share by ten percent (Tr. at 741), although he does not explain how he arrived at this specific amount. He also assigns the United States the orphan shares for Huskon 4, 5, 8, and 9. Tr. at 745. When all of his second-bucket allocation is completed, Mr. Batson assigns 81% of the second bucket to the United States and 19% to El Paso. Tr. at 746.

The Court disagrees with Mr. Batson's baseline. The period represented by the second bucket was the primary waste-generating phase at the Mine Sites – years when the mines were in operation and creating waste piles. El Paso was the key actor in these operations. As will be clearer from the Court's allocation discussion below, the Court can see no justification for assigning the United States a supermajority of liability for mining operations El Paso performed.

In the third bucket, Mr. Batson assigns 100% of the liability to the United States as the only operator during the reclamation phase. Tr. at 746. His assessment is based on El Paso's view that the Nation's reclamation created additional waste by moving too much soil and by moving in radioactive material from off-site. *See* Tr. at 860-61.

The Court's first disagreement is that the United States is not an operator during this phase, as explained above. The Court also finds that the reclamation projects most likely will decrease, rather than increase, the ultimate clean-up costs at the Mine Sites. El Paso has evaluated possible remedies in draft RSEs and EE/CAs for Huskon 12 and 14. *See* Tr. at 677. These represent two of the most contaminated Mine Sites, and yet three of the four remedies proposed by El Paso involve no excavation of the mine pits where wastes were placed during reclamation. Nor does El Paso propose that entirely new caps be placed on the mounds now found where the mine pits once were located. Instead, El Paso proposes that it enhance and maintain the reclamation work performed by the NAML. *See* Ex. 285 at 11-13.

Although the EPA has not responded to El Paso's proposal, it appears likely that El Paso will not be required to excavate the mine pits and move contaminated soil off-site to other locations, particularly given the arid and still-remote positions of the Mine Sites.[21] The Court finds it more likely that El Paso will be required to upgrade caps on the waste piles and improve storm-water run-off and erosion protection systems. It may also be required to address contamination in drainages and other areas that were not addressed in the reclamation work. If this is true, the excavation of waste piles and filling of mine pits performed by the Navajo Nation during reclamation most likely will have reduced, not increased, the response costs at the Mine Sites.

Mr. Werth, El Paso's remediation project manager, testified that the reclamation work will increase remediation costs, but the Court did not find this testimony credible. He suggested that areas on the Mine Sites with the highest gamma readings were in locations that have not been reclaimed, suggesting that reclamation lowered radiation levels. Tr. at 624-25. He testified that erosion of the reclamation mounds will increase remediation costs (*see* Tr. at 621), but there is evidence that the mine sites were eroding prior to the reclamation work (Ex. 189). The Court cannot find that erosion of the capped waste mounds created during reclamation has caused more contamination than would have been caused by erosion of uncovered waste piles left at the sites by El Paso.

Nor did El Paso persuasively show that reclamation made the sites worse by bringing in radioactive fill material from other sites. Mr. Beahm did testify that soil was brought from other locations to provide cover at the Mine Sites, and that some of these locations were other uranium mines. Tr. at 460-63, 516-17. But he did not testify that the material brought to the Mine Sites was contaminated. He noted that the radiation level used by the Nation in reclamation was 25 picocuries per gram, implying that materials near

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[21] El Paso itself asserts that excavation of the filled mine pits today would not allow it to segregate the mixed waste for separate remediation treatment. Tr. at 474.

this level could have been imported for cover, but he did not testify that this actually occurred. *Id.* El Paso provides a long string cite of various exhibits and deposition pages to support its position (Doc. 187 at 11-12), but none of the cited evidence shows that contaminated material was brought onto the Mine Sites during reclamation. To the contrary, at least one historical document states that the imported material was "clean." Ex. 224. The Court accordingly does not find that reclamation made the sites more contaminated as El Paso asserts.

To summarize, the Court finds El Paso's proposed allocation to be quite unreliable – contrived to assign maximum responsibility to the United States.

B. The United States' Proposed Allocation.

The government's allocation expert, Mr. Low, did not present a framework similar to Mr. Batson's. He instead opined that the United States' trust ownership of the land should reduce the costs allocated to it. Tr. at 1298. And he emphasized involvement of the parties, benefits to the parties, and cooperation as the three main factors for the Court to consider. Tr. at 1302-08. Mr. Low opined that the equitable share for the United States in this case should not exceed 25%, but he did not fully explain how he applied his equitable factors to reach this proposed limit. The Court does not find his allocation analysis helpful.

C. The Court's Allocation.

In apportioning response costs among responsible parties, CERCLA requires only that the Court use "such equitable factors as the court determines are appropriate." 42 U.S.C. 9613(f)(1). Courts often start allocation analysis with the Gore factors originally contained in a bill proposed by then-Congressman Al Gore. *See Burlington*, 520 F.3d at 940 n.26. These include (1) the ability of the parties to demonstrate that their contribution to a discharge, release or disposal of a hazardous waste can be distinguished; (2) the amount of the hazardous waste involved; (3) the degree of toxicity of the hazardous waste; (4) the degree of involvement by the parties in the generation, transportation, treatment, storage, or disposal of the hazardous waste; (5) the degree of care exercised by the parties with respect to the hazardous waste, taking into account the characteristics of such hazardous waste; and (6) the degree of cooperation by the parties with federal, state, or local officials to prevent any harm to the public health or the environment. *See TDY Holdings, LLC v. United States*, 885 F.3d 1142, 1146 (9th Cir. 2018). Courts also consider (1) the extent to which the clean-up costs are attributable to wastes for which a party is responsible; (2) the party's level of culpability; (3) the degree to which the party benefitted from disposal of the waste; and (4) the party's ability to pay its share of the costs. *United States v. Davis*, 31 F. Supp. 2d 45, 63 (D.R.I 1998). The Court will consider all of these factors.

1. Gore Factors.

a. Distinguishability of Each Party's Waste.

There is only one type of waste at issue in this case – radioactive remnants of uranium mining. Both parties claim the other is partially responsible for this single form of waste. The Court cannot accept El Paso's three-bucket approach for reasons explained above, and finds no other reasonable basis for distinguishing one party's waste from the other's.

b. Amount of Hazardous Waste.

The Court cannot identify a volume of hazardous waste that can be neatly attributed to one party and not the other. The fight is over waste that has not been quantified. As noted, the Court does not agree with El Paso's attempt to estimate a soil volume attributable to each of the parties.

c. Degree of Toxicity.

With only one type of contaminant blended in the soil throughout the Mine Sites, this factor is not relevant. *See Gavora, Inc. v. City of Fairbanks*, No. 4:15-cv-00015-SLG, 2017 WL 3161626, at *8 (D. Alaska July 25, 2017) (noting that this factor is most relevant when there are two types of discharges by two distinct actors, and one is more toxic).

d. The Degree of Involvement.

This is the most important factor in this case. El Paso, as the Mine Sites' operator, was the primary party responsible for the generation and disposal of waste at the sites. El

Paso excavated uranium ore in open pit mines, stockpiled ore on the property, and stockpiled waste on the property. El Paso also built and operated the Tuba City mill, which purchased uranium from its own mines and others in the area.

The United States did not directly oversee El Paso's mining operations or instruct it on where or how to dispose of waste. But the United States did own the land in trust for the Navajo Nation and was obligated to hold it for the best interests of the Nation. In this capacity, the United States reviewed and approved permits and leases, included various oversight powers in the permits and leases, advised the Nation on its uranium regulation activities, and collected rents and royalties for the Nation's benefit. The Court concludes that the United States should be assessed a 5% share for these ownership activities.

But this assessment does not fully account for the government's substantial involvement in this case. The United States did much more than simply act in its trust capacity for the Nation's benefit. It created the DUPP to obtain uranium and further the national defense. It created the market for uranium by publishing the Circulars and establishing buying stations. It encouraged uranium mining throughout the United States and in the Cameron area by researching best exploration and mining practices and engaging in exploration and road-building. It was the only purchaser of uranium ore, and it reviewed and approved El Paso's construction and operation of the Tuba City mill. Charlie's Steen's million-dollar discovery may have sparked the uranium "gold rush" in the minds of the public (Tr. at 1600), but the United States played a primary role in the creation and growth of uranium mining in the 1950s, including at the Mine Sites.

How, then, does the Court balance the parties' respective roles – El Paso's for-profit, on-the-ground, excavation and disposal of the uranium waste that must now be remediated, together with its operation of the mill that created a local uranium purchaser for its mines and others, versus the government's role in promoting, facilitating, and assisting in uranium mine development generally and its exploration of some of the Mine Sites?

The Court begins by noting that El Paso was directly involved in every step of waste generation. With the exception of the relatively small orphan shares that will be assigned below, El Paso moved every cubic foot of radioactive soil that has created an environmental hazard at the sites. It opened the mines, hired the workers, acquired the machinery, excavated the soil, created the waste and ore piles, loaded the trucks, and blended the ore. It decided how long to operate each mine, how much soil to disturb, and, within the limits of the mines' capacities, how much ore to produce. It built and operated the mill that made the Cameron area mines, including its own mines, more profitable. It set the ore grade cut-off at the mill that determined what levels of waste would be left at mines. In short, El Paso was the principal actor, the primarily responsible party for generating the waste at issue in this case. El Paso was not dragooned by the United States into this activity. Like many others drawn to uranium mining in the 1950s and 1960s, it sought to make a profit and dutifully reported its mining profits to management and shareholders each year.

The United States, by contrast, was not an on-site actor in the waste generating or disposal activities. With the exception of some exploration work at Huskon 12, 14, and 17 in the early years, it had no direct involvement in the mining or waste generation. It did, to be sure, exert influence over those operations. It created financial incentives, promoted uranium mining on the Colorado Plateau, approved construction of the mill, and purchased uranium ore and concentrate.

Comparing these two parties, the Court concludes that El Paso was the primary actor but that the United States should bear some meaningful share of the responsibility. Therefore, in addition to the 5% that the Court has assigned the United States for its trust ownership of the land and the actions it took to oversee and approve permits and leases, the Court assigns 25% to the United States for creating the conditions and market that led to mining at the Mine Sites, and for its limited exploration at three sites. The Court assigns 70% to El Paso for its role as the primary generator of the contamination – an amount that will be adjusted slightly when the Court considers the relative benefits to the parties.

e. Degree of Cooperation.

This factor does not tip the balance either way. Both parties have been appropriately responsive to their environmental responsibilities.

El Paso left the Mine Sites exactly how the Navajo Nation and the United States requested. The government approved termination of the leases and returned El Paso's bonds. *See* Tr. at 383; Ex. 172. Leases required El Paso to leave the Mine Sites timbered, which for pit mining meant leaving the pits open. In the years that followed, El Paso had no interest in or responsibility for the Mine Sites, nor has the United States produced evidence that El Paso was asked to participate in the reclamation. Since El Paso received a PRP notice from the EPA, it has been compliant. *See* Tr. at 610-11. El Paso appears to have done everything the EPA has asked, on schedules agreed to by the EPA.[22]

El Paso asserts that the United States and the Navajo Nation left the Mine Sites unattended from 1962 to the 1990s, allowing erosion and other health hazards to continue and increase. *See* Tr. at 746-47. But in response to concerns about public health and the state of the Mine Sites, the United States funded the Navajo Nation's reclamation through a SMCRA grant of $2.4 million. The reclamation significantly mitigated immediate health hazards and likely reduced not only the continuing spread of radioactive material through erosion, but also the ultimate remediation costs as noted above.

f. The Degree of Care.

There is no evidence El Paso mined inappropriately or disposed of waste outside of its lease provisions or the customs of the 1950s and 1960s. Similarly, there is no evidence that the United States acted irresponsibly in operating the DUPP or in its involvement with uranium mines. This factor does not affect the Court's allocation.

2. Other Factors.

a. The Relative Benefits to the Parties.

Courts may consider both financial and non-monetary benefits when considering the degree to which parties benefited. *See, e.g., Cadillac Fairveiw*, 299 F.3d at 1026 (World War II rubber production); *Shell Oil Co.*, 294 F.3d at 1060 (aviation gasoline as

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[22] The Court cannot accept the United States' argument that El Paso should have done more after the *Neztsosie* tort litigation. *See* Tr. at 1474. The parties presented no evidence of the litigation's outcome or of any right El Paso had to access or control the Mine Sites at the time.

part of the war effort). The clear benefit to El Paso was the profits it received from the mining activities. Tr. at 1056-58; Exs. 1032-1056.

For the United States, the benefit was of a different kind. The threat of nuclear war was real when the government started the DUPP. Uranium ore from the Colorado Plateau was considered vital to the Country's national security, and the federal government needed private companies with experience in mining. The Cold War effort ultimately succeeded; the United States obtained enough uranium and produced enough weapons to maintain security during the Cold War.

In assessing the benefit to the United States from domestic uranium production, however, the Court cannot ignore the relatively small portion of government uranium needs that was filled by the Cameron area mines. In 1961, all of Arizona provided only 3.2% of the uranium ore produced in the United States (Ex. 1331), a percentage comparable to other years (Tr. at 918-19). Mr. Beahm testified that production from the Cameron mines was a "tiny" portion of domestic output. Tr. at 498; *see also* Exs. 1072 at 8; 1330; 1331. Indeed, he testified that a single mine in Wyoming produced more uranium ore in one year than all of the mines in the Cameron area produced during their entire lives. Tr. at 497.

Thus, although the benefit to the United States from overall uranium procurement was substantial, the Mine Sites contributed only a small portion of that benefit. The Court will assign an additional 5% to the United States for this factor, raising its total allocation to 35%, with 65% for El Paso.

b. Tuba City Mill Remediation.

The United States asserts that it should be credited for money spent on the Tuba City mill remediation. The Court does not agree. As discussed above, when El Paso closed the mill it followed the procedures of the Arizona AEC and instructions from the BOM. When it enacted UMCTRA, Congress opted not to impose liability on mill operators and instead assumed responsibility for mills used in the uranium procurement program. Given this conscious choice by Congress, it would be improper to use CERCLA to shift mill clean-up costs to El Paso.

c. Degree of Knowledge and Risk.

Both parties knew of and understood the risks associated with uranium mining in the 1950s and 1960s. Both employed geologists and mining experts. The Court cannot conclude that one party had more knowledge than the other.

d. Orphan Share.

The orphan shares in this case arise from the operations of defunct mining companies – Utco Uranium, Cameron Mining, B.C. Associates, Domino Company, and H.R. Rodgers. El Paso proposes that the Court assign nine sites to Rare Metals, where Rare Metals ceased operations prior to the ultimate closure of those sites, and the remaining sites to the United States because it owned the land and had more connections with the other orphan companies. Tr. at 744-45. But El Paso's proposed assignment of 100% of the remainder to the United States ignores El Paso's continued relationship with the mines through its operation of the Tuba City mill, which facilitated their mining and profited from their ore production. *See* Tr. at 1335-36, 1478. The Court concludes that a pro rata allocation of the orphan shares is more equitable.

3. Supporting Case Law.

The Court arrives at the 35%–65% allocation based on the factors considered above. The Court has also considered a number of other cases that have engaged in CERCLA allocations and finds that they support this division of responsibility.

a. Newmont USA Ltd.

The most relevant case is *United States v. Newmont USA Ltd.*, No. CV-05-020-JLQ, 2008 WL 4621566 (E.D. Wash. Oct. 17, 2008), which concerned the relative CERCLA liabilities of the United States and two mining companies for an open pit uranium mine operated during the 1950s, 1960s, and 1970s on land held in trust by the United States for the Spokane Indian Tribe. *Id.* at *1. The involvement of the United States in *Newmont* was even greater than its involvement in this case.

Leases for the Newmont mine site were executed and approved by DOI, as were later assignments of the leases. *Id.* at *4. The AEC engaged in exploratory drilling at the mine site, executed a series of small ore procurement contracts with the mining companies, performed geologic surveying, provided free testing and assaying, guaranteed minimum ore prices through the Circulars, and was the only purchaser of uranium when the mine was opened. *Id.* at *8-9. As here, the companies elected to construct a mill for the uranium ore, and the AEC executed a contract for the production and sale of uranium concentrate. *Id.* at *10. Once the mill was operational, the AEC inspected it regularly, and the USGS inspected the mine. *Id.* at *13. The AEC entered into additional contracts with the mining companies, and DOI prepared and entered into renewed leases. *Id.* at *13-14. The leases included obligations to the United States, not to the Spokane Tribe, allowed DOI to audit the mining companies' records, empowered DOI to suspend operations, and provided for payment of rents and royalties to the BIA for the benefit of the Tribe. *Id.* at *14. Following a short closure of the mine while prices would not support a profitable operation, mining resumed and uranium was sold to various private electric utilities. *Id.* at *16. Various federal agencies, including the BIA and USGS, resumed their inspections of the mine. *Id.* The DOI approved revised royalty agreements between the mining companies and the Tribe, and the USGS was extensively involved in various reclamation and mitigation activities at the mine. *Id.* at *17-21.

In addition to this direct involvement with the mine and the mill, the *Newmont* court found that the mine's "uranium production provided the United States with a significant, material benefit by supplying uranium for the nation's nuclear weapon and energy needs during the Cold War." *Id.* at *43. The *Newmont* court also found that "[w]ithout the encouragement and direct involvement of the United States, the Mine would not and could not have been developed in the 1950s and 60s." *Id.* at *44.

Newmont assigned one-third of the CERCLA liability to the United States and two-thirds to the mining companies. The district court found that the government knew of the inherent environmental problems associated with open pit mining and that uranium production provided the United States with a vital national benefit for the Cold War and commercial nuclear power. Additionally, the United States had authority to inspect the mining operations, monitor water quality, control rents and royalties, conduct audits, and set the amount of the reclamation bond. *Id.* at *60-61. *Newmont* assigned two-thirds of the CERCLA liability to the mining companies because they "conducted the mining activities that have caused the environmental problems that are now being addressed by EPA." *Id.* at *61. The companies also "sought to profit financially and did profit from the operation," and "demonstrated [a] lack of care and recalcitrance in reclaiming the mine site." *Id.*

The Court finds that *Newmont* corroborates the 35% allocation to the government in this case. On very similar facts, the United States was assigned one-third of the CERCLA responsibility. Although it is true that the mining companies in *Newmont* were recalcitrant in their environmental responsibilities and El Paso is not, the United States also had greater involvement with the mine than here. *See* Tr. at 1312 (Mr. Low testifying that there was much more government oversight at the Newmont mine).[23]

b. Lockheed Martin Corp.

Lockheed Martin filed suit against the United States seeking contribution under CERCLA for clean-up of three solid propellant rocket production facilities. *See Lockheed Martin Corp. v. United States*, 35 F. Supp. 3d 92, 96 (D.D.C. 2014). Both parties admitted PRP status, and the court held a bench trial. *Id.* The Court allocated the costs across three facilities, giving 19 to 29% to the United States and 71 to 81% to Lockheed Martin. *Id.*

Lockheed Martin researched, developed, and operated the sites in support of military and scientific programs critical to the Cold War. *Id.* at 98. The United States, as the only purchaser of the solid propellant rockets, controlled the solid propellant industry. *Id* at 99. The government set the specifications for the propellant rocket motors, but otherwise had limited involvement in Lockheed's technical development process. *Id.*

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[23] El Paso argues that the United States' share was reduced in *Newmont* because the mine produced only 11% of the AEC's total uranium input, while here the AEC purchased 100% of the Mine Sites' uranium. These two numbers are not comparable. One represents input to the AEC's program and the other represents what AEC purchased from particular mines. If the Court were to compare input to the AEC, all Arizona mines provided only 3.2%, with the Mine Sites providing even less. *See* Ex. 1331.

at 102. Because Lockheed Martin was the sole operator of the sites, the court found that it should shoulder a larger portion or the liability for response costs. *Id.* at 150.

c. TDY Holdings.

TDY Holdings, LLC and its predecessor, Ryan Aeronautical Company (collectively "TDY"), filed a claim against the United States for equitable allocation of the costs TDY incurred cleaning up hazardous wastes at an aeronautical manufacturing plant. *See TDY Holdings, LLC v. United States*, No. 07-CV-787-CAB-BGS, 2019 WL 1012001, at *1 (S.D. Cal., Mar. 1, 2019). Contamination at the site was caused by the sole operator, TDY, and there was no evidence that operational or disposal decisions were made by the government. *Id.* at *5. The government required that chromium be used in the manufacturing process, and the court accordingly allocated 5% of the soil remediation costs to it. *Id.* The court also allocated 10% of the ground clean-up costs to the government because it recommended that chlorinated solvents be discharged to a sewer line. *Id.*

d. Cadillac Fairview.

Cadillac Fairview involved allocation of clean-up costs associated with a synthetic rubber facility operated by Dow Chemical during World War II. 299 F.3d at 1022. At the time, the need for synthetic rubber was so urgent that the government had Dow Chemical build the plant and operate it as "an agent" of the government at the "expense and risk" of the government. *Id.* The government was found liable as an owner, operator, and arranger. *Id.* at 1025. Because of its agency relationship and express agreement to hold Dow Chemical harmless, the district court allocated 100% of the response costs to the government. *Id.* at 1026.

e. Shell Oil Co.

As noted above, *Shell Oil* involved the clean-up of a site contaminated with waste from the production of aviation fuel during World War II. 294 F.3d at 1048. The district court allocated 100% of the liability for remediation of the benzol waste to the United States. *Id.* at 1059. The district court found that the clean-up costs for such wastes were part of the war effort for which the American public should pay. *Id.* at 1060. Additionally, the United States refused to make tank cars available for transporting the waste and refused to allocate resources to build reprocessing plants, resulting in the contamination. *Id.*

f. Other Cases Conclusion.

This case is most similar to *Newmont*, which involved uranium mining, tribal-land ownership, the DUPP, and benefits to the United States. The government exercised more day-to-day oversight of the mines in *Newmont* than here, but the companies were less cooperative in the environmental clean-up. *See* 2008 WL 4621566, at *44. The Court's allocation in this case seems appropriately similar to *Newmont*'s.

Lockheed Martin also presents a similar situation, where the government was not an operator despite setting requirements for the final products. Assigning El Paso the majority of the allocation due to its primary operator status aligns with *Lockheed Martin*.

This case is distinguishable from *Cadillac Fairview* and *TDY*. In *Cadillac Fairview*, the private operator was an agent of and held harmless by the government. *TDY* involved the discharge of multiple substances, only some of which could be attributed to the government's products or requests.

The allocation in *Shell Oil* clearly differs from the allocation here. After a full trial, the district court found that "had the future CERCLA regime been foreseen by the parties, the Government would have agreed to pay for the costs of the cleanup of the McColl Site (or any other unforeseen cost) in the blink of an eye[.]" 294 F.3d at 1060. The district court also found that government decisions about tank cars and reprocessing plants resulted in disposal of the waste and the present contamination. *Id.* The Court does not make the same findings here, and therefore finds the allocation in *Shell Oil* distinguishable.

IV. Application of § 107(n).

CERCLA provides that "[t]he liability of a fiduciary under any provision of this chapter for the release or threatened release of a hazardous substance at, from, or in connection with a vessel or facility held in a fiduciary capacity shall not exceed the assets held in the fiduciary capacity." 42 U.S.C. § 9607(n)(1). The United States argues that this provision limits its liability because it owns the Mine Sites in trust for the Navajo Nation.

El Paso does not dispute that the government acted as a fiduciary with respect to the Nation and the land ownership.

Section 107(n) does not eliminate CERCLA liability. Rather, it states that if a fiduciary becomes liable under one of CERCLA's four categories, the assets from which that liability can be satisfied are limited. "The liability of a fiduciary under any provision of this chapter . . . shall not exceed the assets held in the fiduciary capacity." *Id.* Consequently, when a party faces CERCLA liability for actions taken as a fiduciary – usually land ownership – the party is not personally liable and the CERCLA recovery may come only from assets held in the fiduciary capacity. *Canadyne-Georgia Corp. v. NationsBank, N.A. (South)*, 183 F.3d 1269, 1274 (11th Cir. 1999).

In this case, the United States' owner liability arises from its ownership of land as a trustee, and CERCLA states that a fiduciary includes a trustee. 42. U.S.C. § 9607(n)(5)(i). Such owner liability, therefore, may be satisfied only out of assets held in trust by the United States and not from the general U.S. Treasury. As noted above, the Court assigns 5% of the liability to the United States based solely on its role as owner of the land and the actions it took in that role – approving permits and leases, including various oversight powers in the permits and leases, advising on regulations, and collecting rents and royalties for the benefit of the Nation.

The United States' operator liability arises from exploration actions of the AEC at the Mine Sites, not from its fiduciary land ownership, and therefore is not limited to trust assets by § 107(n). *See* 42 U.S.C. § 9607(n)(2) (Section 107(n) "does not apply to the extent that a person is liable under this chapter independently of the person's ownership of a vessel or facility as a fiduciary or actions taken in a fiduciary capacity."). The Court concludes that the 25% share allocated to the United States for its purposeful promotion of uranium mining in the 1950s, and the additional 5% allocated to it because of the benefits it received from uranium production during the Cold War, should be assigned to its operator liability, not its owner liability. The government's creation of the DUPP was not a result of its land ownership for the Navajo Nation. Rather, it was undertaken by the AEC for a very different purpose – enhancing national defense during the Cold War. It was motivated by the same forces that led the AEC to engage in the exploration activities that give rise to its operator liability in this case. Because the Court allocates this 30% share to the United States' operator liability, it is not subject to the limitation of § 107(n). *Id.*

The United States suggests that there are no assets available in trust to satisfy the portion allocated for owner liability. It cites the Indian Non-Intercourse Act as holding that all assets held in trust are inalienable. But the Act is limited to land: "[n]o purchase, grant, lease, or other conveyance *of lands, or of any title or claim thereto*, from any Indian nation or tribe of Indians, shall be of any validity in law or equity, unless the same be made by treaty or convention entered into pursuant to the Constitution." 25 U.S.C. § 177 (emphasis added). The trust assets include more than land. Relevant regulations state that "[t]rust assets mean trust lands, natural resources, *trust funds, or other assets* held by the federal government in trust for Indian tribes and individual Indians." 25 C.F.R. § 115.002 (emphasis added); *see also id.* ("Trust funds means money derived from the sale or use of trust lands, restricted fee lands, or trust resources and any other money that the Secretary must accept into trust."). The government conceded in its proposed findings and conclusions that "[t]he assets held in the fiduciary capacity include the trust lands, natural resources, *and other assets such as revenues*, all of which are held for the benefit of the Navajo Nation and individual Navajo tribal members." Doc. 157 ¶ 82 (emphasis added). The United States has presented no evidence to show that non-land trust assets are insufficient to satisfy the 5% owner liability allocated above.

El Paso cites § 107(n)(7)(A) to suggest that the limitation in § 107(n)(1) does not apply at all in this case. Doc. 187 at 14. El Paso asserts that "the AEC acted in a capacity other than [as] a fiduciary during its mining activities at the Mine Sites[.]" *Id.* But § 107(n)(7)(A) has other requirements that El Paso does not address. *See* § 107(n)(7)(A)(ii), (B)(ii).

El Paso also argues that § 107(n) does not apply because the United States does not fall within the "safe harbor" provision in § 107(n)(4)(H). Doc. 187 at 15. This argument conflates § 107(n)(1) and § 107(n)(4), which are clearly different provisions with different purposes. El Paso cites no authority to suggest that a party which does not satisfy the safe harbor provision in § 107(n)(4)(H) cannot receive the benefits of § 107(n)(1), and the statute certainly does not say so.

In summary, § 107(n) has the following effect in this case: the 5% allocated to the United States for its ownership in trust of the Mine Sites, and for actions it took as the land owner and trustee, is recoverable only from trust assets. The 30% allocated to the United States as a CERCLA operator is not subject to this limitation and may be recovered from the United States Treasury.

V. Declaratory Relief.

As noted above, the parties agree that the Court may enter declaratory relief on the allocation of response costs other than the specific amounts sought by El Paso. CERCLA provides for declaratory relief in an action under § 107, but is silent on the availability of such relief for contribution claims under § 113(f). *See* 42 U.S.C. § 9613(g)(2). Courts have held, nonetheless, that declaratory relief may be entered in CERCLA contribution actions. *See Newmont*, 2008 WL 4621566, at *62; *Boeing Co. v. Cascade Corp.*, 920 F.Supp. 1121, 1140 (D. Or. 1996); *cf. Cadillac Fairview*, 840 F.2d at 696 (establishing prerequisites for declaratory judgments in CERCLA cases).

IT IS ORDERED:

1. With respect to El Paso's claim for response costs of $1,393,448 through August 2016, and $502,500 paid to the United States, 65% of the liability for these costs is allocated to El Paso and 35% to the United States. The United States shall reimburse El Paso for 35% of these costs, but the 5% allocated to the United States on the basis of owner liability may be satisfied only out of trust assets.

2. With respect to other response costs incurred to date and future response costs, the Court enters this declaratory relief: 65% of the liability for these costs is allocated to El Paso and 35% to the United States, but the 5% allocated to the United States on the basis of owner liability may be satisfied only out of trust assets.

3. The Clerk is directed to enter judgment consistent with this order and terminate this action.

Dated this 16th day of April, 2019.

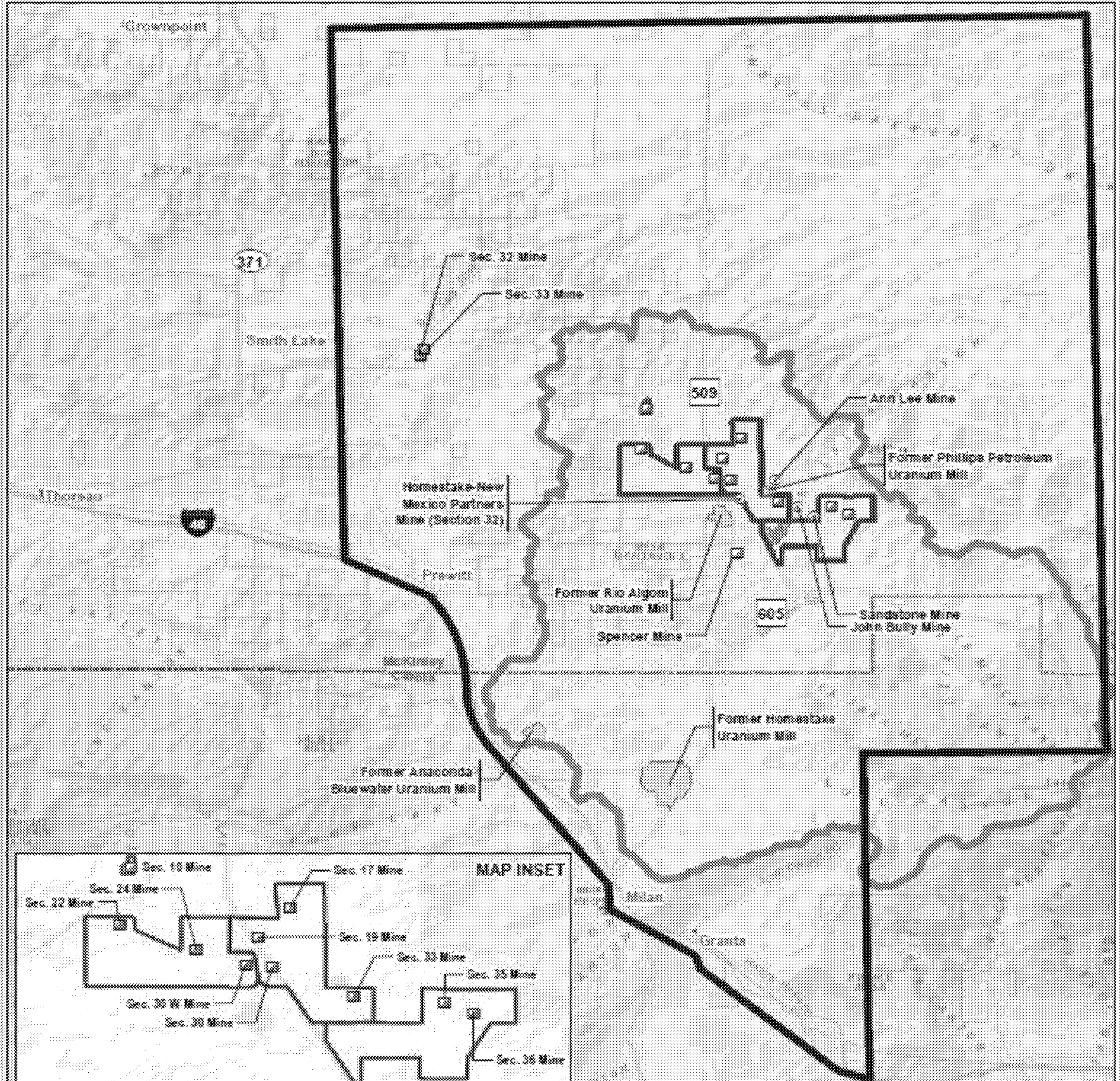
David G. Campbell

David G. Campbell
Senior United States District Judge

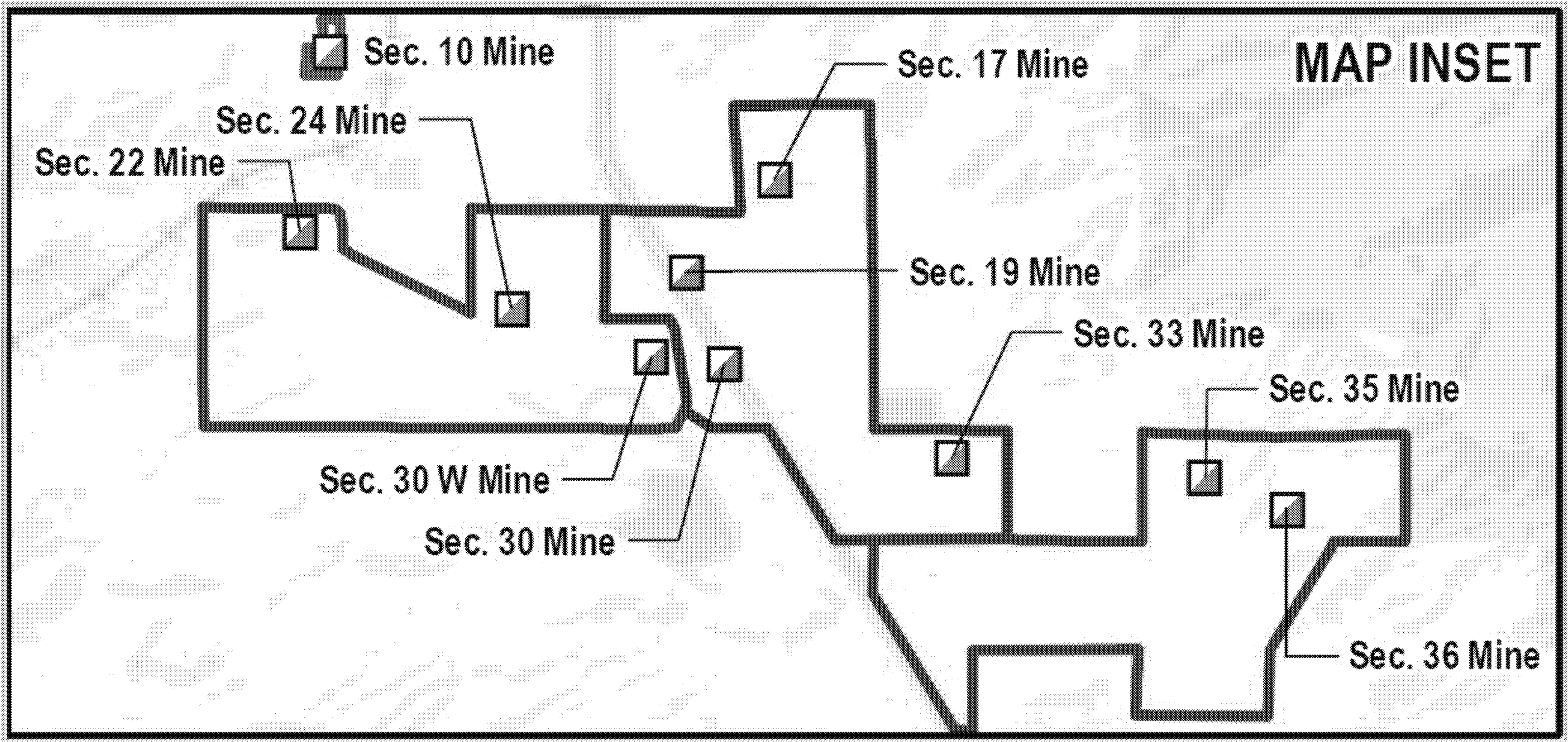
US EPA REGION 6

REMOVAL BRANCH
SURFACE INVESTIGATION

WARREN ZEHNER
ANISH PATEL



FOR DISCUSSION PURPOSES ONLY



FOR DISCUSSION PURPOSES ONLY

REMOVAL ACTION OBJECTIVES

Mitigate actual or potential risks to human health and/or the environment posed by excess radiological on-site contamination.

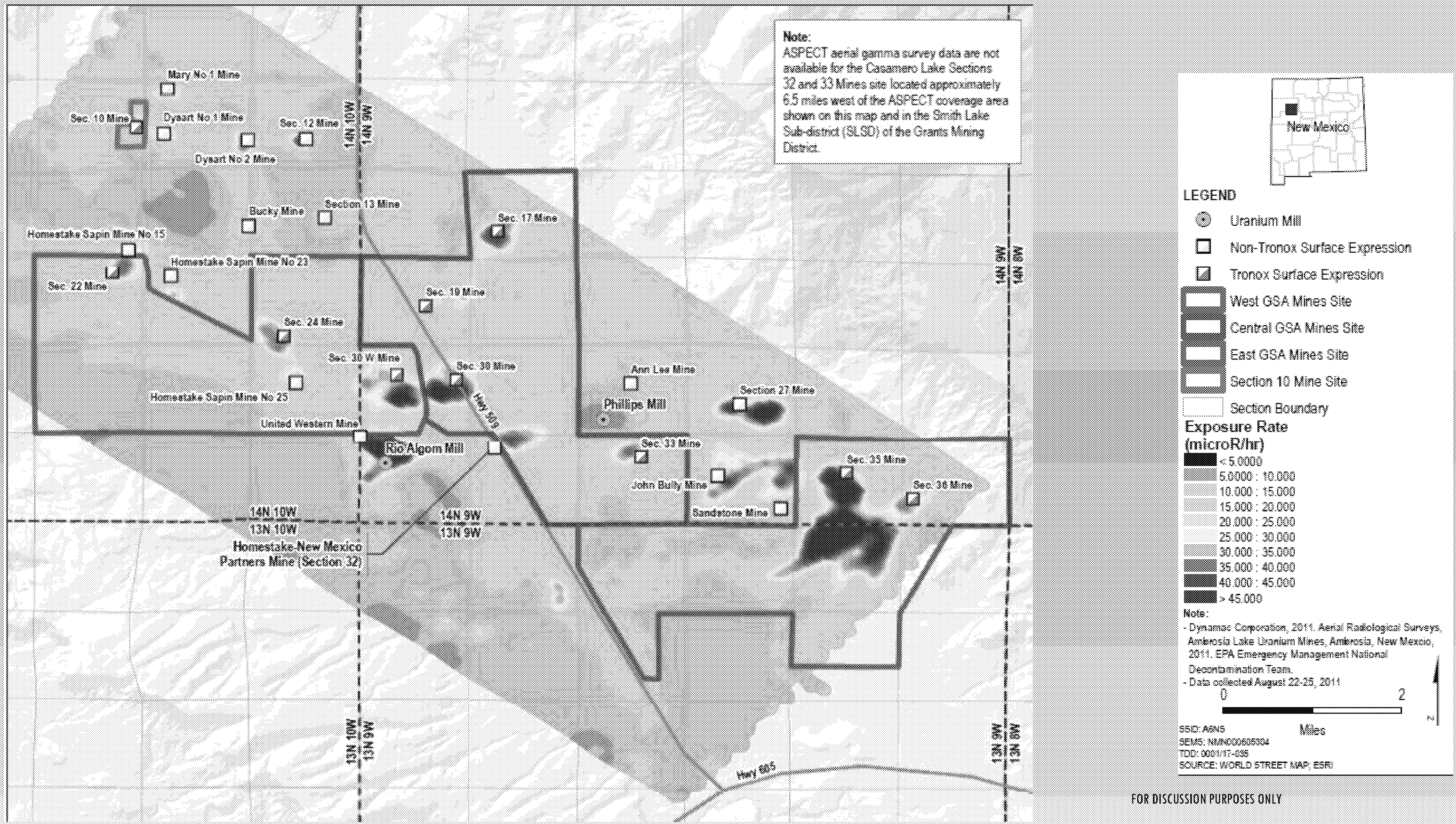
Projected future land use of non-residential livestock grazing.

Address excess radiological contamination in soil greater than the risk-based removal action level.

RISK ASSESSMENT BASED SITE SPECIFIC REMOVAL ACTION THRESHOLD VALUE

An action level, inclusive of background conditions is proposed for the following reasons:

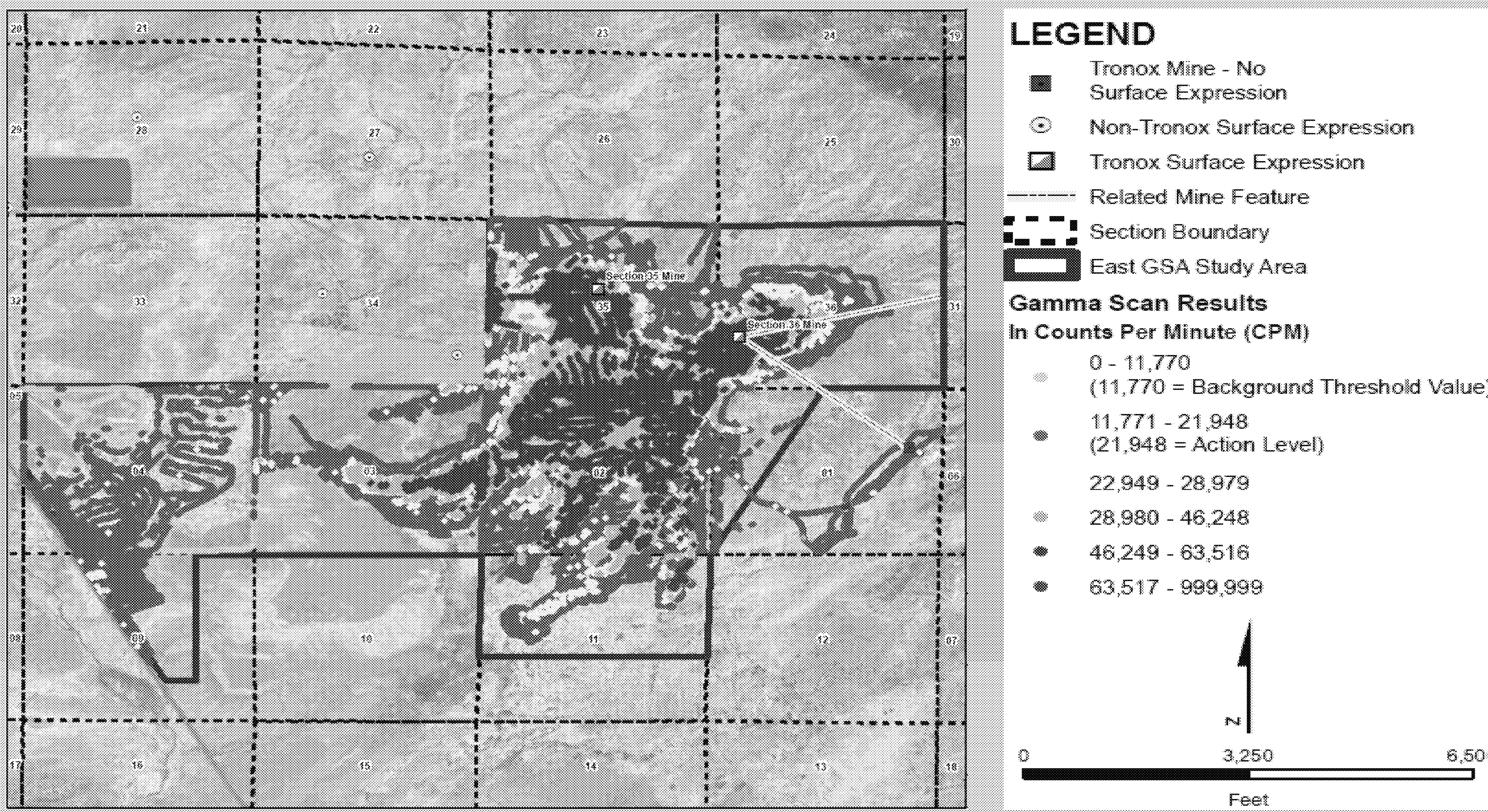
- Within the risk range (10^{-6} to 10^{-4} overall excess cancer risks) cited in the NCP (40 CFR 300.430(e)(2)(i)).
- It is less than the risk, 3×10^{-4}, that EPA has a history of accepting for radionuclides at uranium mining-waste sites as protective, per discussion with OSRTI.
- It is distinguishable from background and therefore measurable in the field.
- It is above the analytical detection limit.
- It meets the standard (5.0 pCi/g Ra-226 above background, averaged over the first 15 centimeters of soil below the surface, averaged over any area of 100 square meters) set forth in the State of New Mexico's *Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in New Mexico* (NMEMNRD, et al., March 2016).



FOR DISCUSSION PURPOSES ONLY

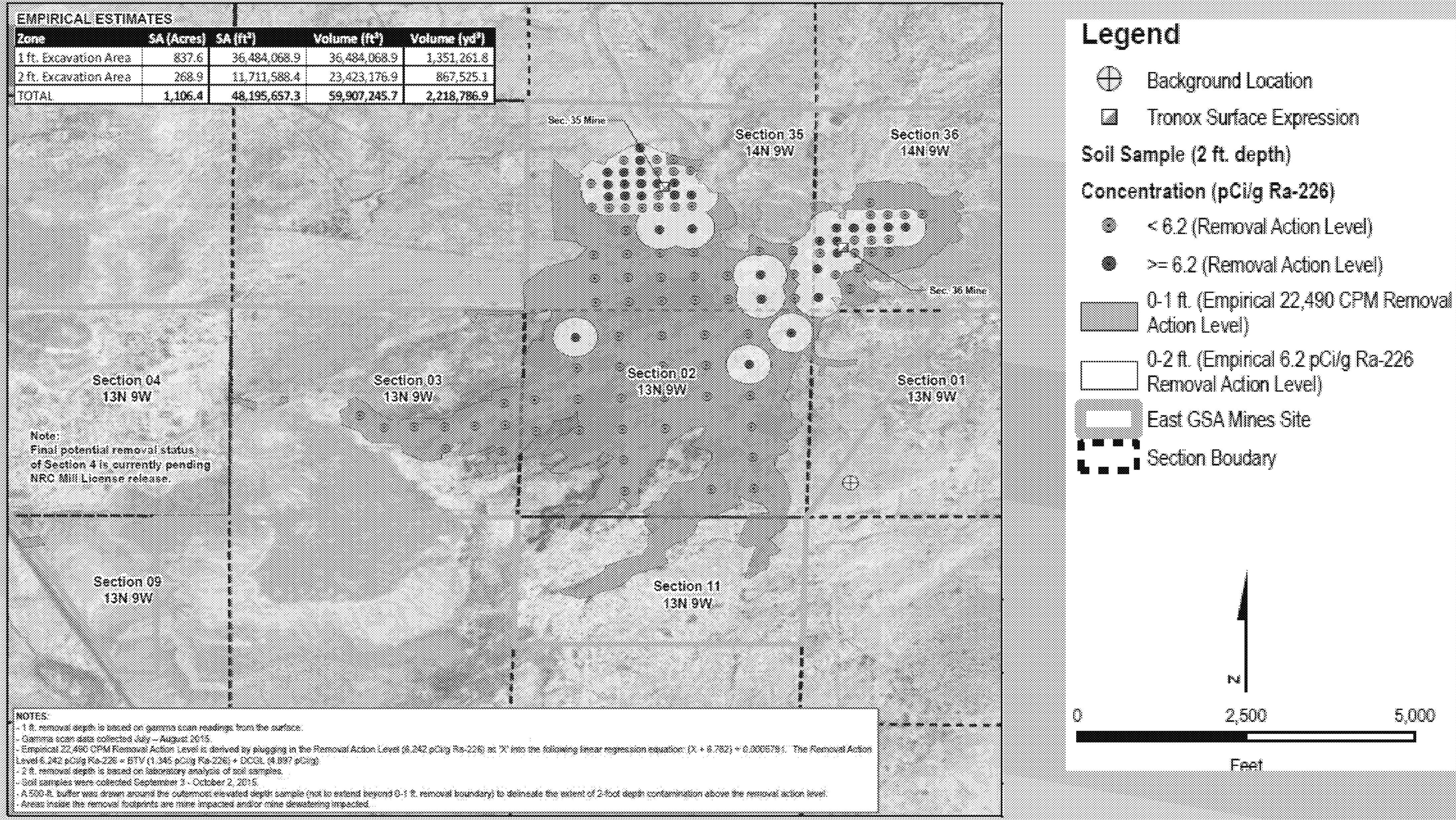
TRONOX NAUM EAST GEOGRAPHIC SUB-AREA

EAST GSA GAMMA SCAN



FOR DISCUSSION PURPOSES ONLY

EAST GSA REMOVAL FOOTPRINT



EMPIRICAL ESTIMATES

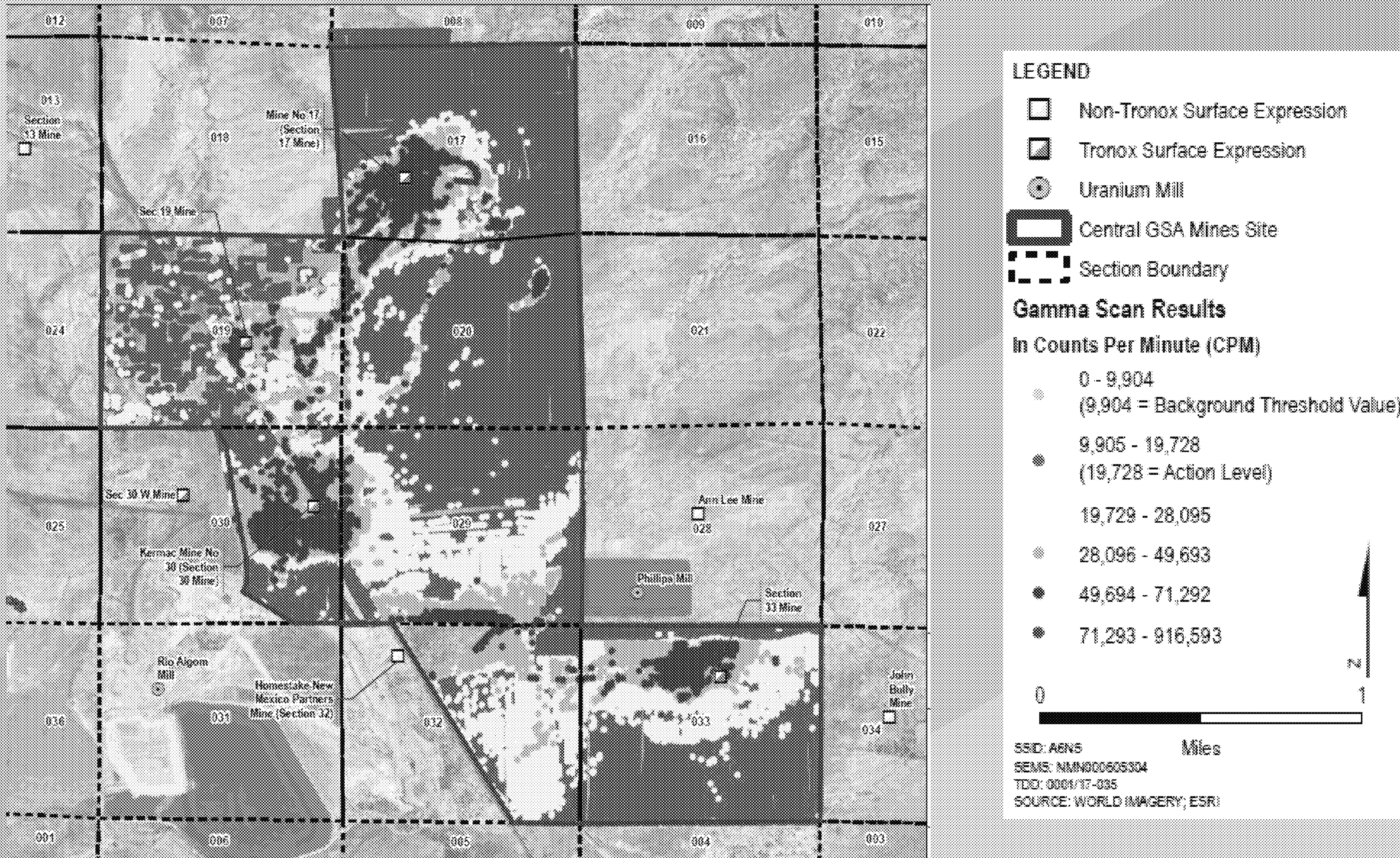
Zone	SA (Acres)	SA (ft²)	Volume (ft³)	Volume (yd³)
1 ft. Excavation Area	837.6	36,484,068.9	36,484,068.9	1,351,261.8
2 ft. Excavation Area	268.9	11,711,588.4	23,423,176.9	867,525.1
TOTAL	**1,106.4**	**48,195,657.3**	**59,907,245.7**	**2,218,786.9**

NOTES:
- 1 ft. removal depth is based on gamma scan readings from the surface.
- Gamma scan data collected July – August 2015.
- Empirical 22,490 CPM Removal Action Level is derived by plugging in the Removal Action Level (6.242 pCi/g Ra-226) as 'X' into the following linear regression equation: (X + 6.782) ÷ 0.0005791. The Removal Action Level 6.242 pCi/g Ra-226 = BTV (1.345 pCi/g Ra-226) + DCGL (4.897 pCi/g)
- 2 ft. removal depth is based on laboratory analysis of soil samples.
- Soil samples were collected September 3 - October 2, 2015.
- A 500-ft. buffer was drawn around the outermost elevated depth sample (not to extend beyond 0-1 ft. removal boundary) to delineate the extent of 2-foot depth contamination above the removal action level.
- Areas inside the removal footprints are mine impacted and/or mine dewatering impacted.

FOR DISCUSSION PURPOSES ONLY

TRONOX NAUM CENTRAL GEOGRAPHIC SUB-AREA

CENTRAL GSA GAMMA SCAN



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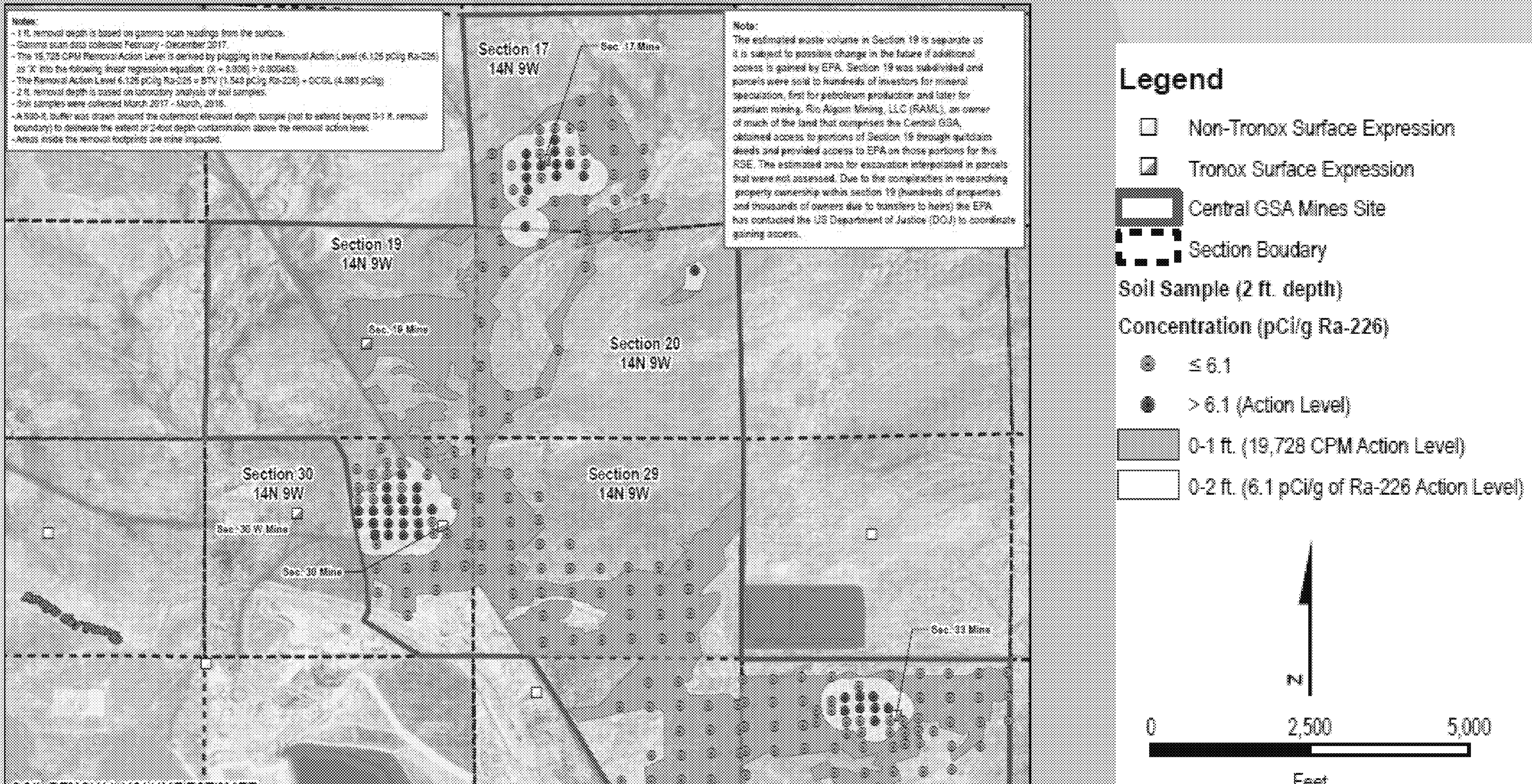
CENTRAL GSA REMOVAL FOOTPRINT

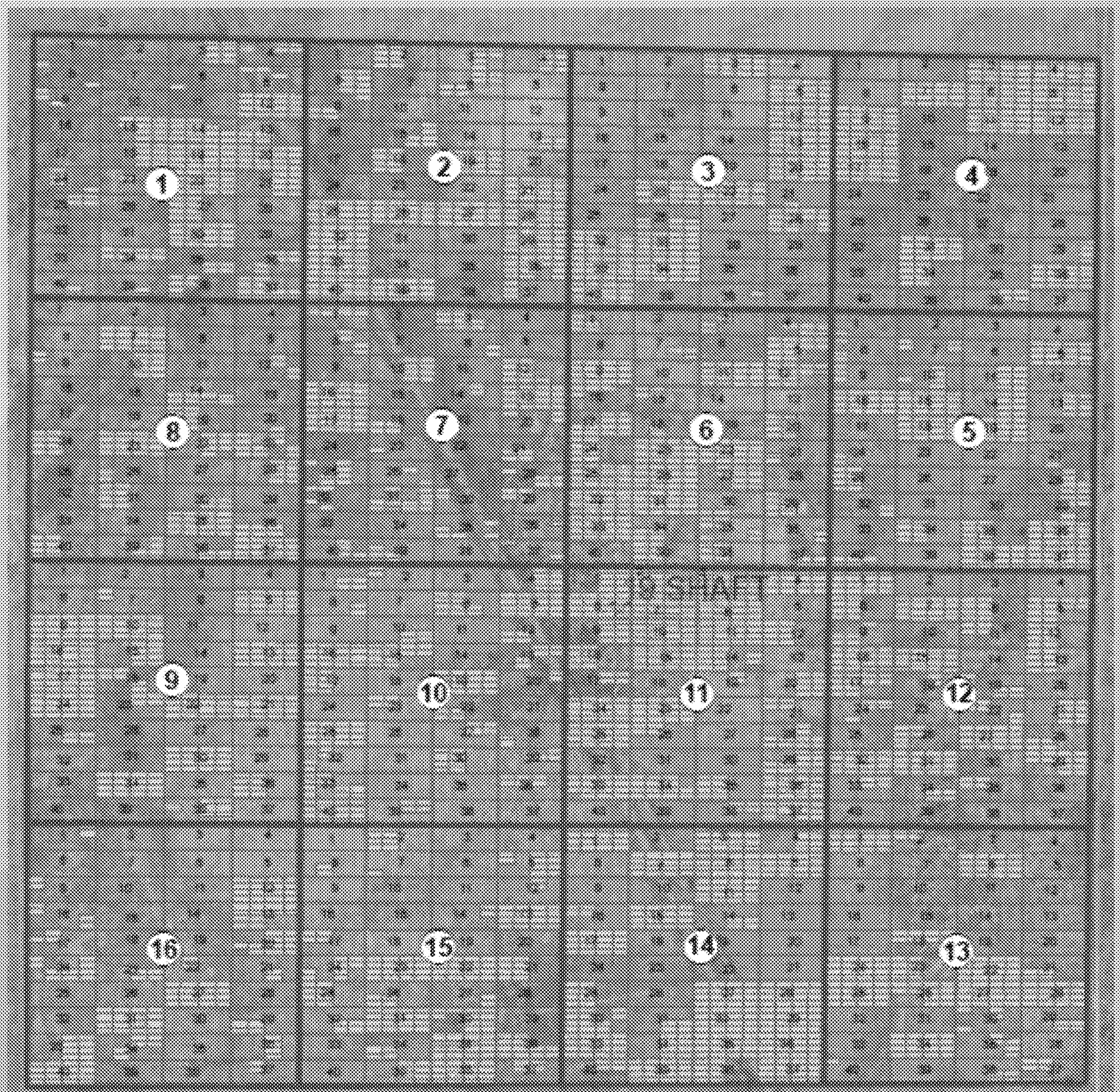


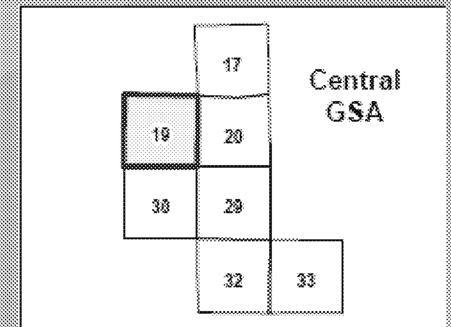
SOIL REMOVAL VOLUME ESTIMATE

Zone	Surface Area		Volume
	Square Feet	Acres	Cubic Yards
1 ft. Excavation Area (Except Section 19)	40,237,825	924	1,490,290
2 ft. Excavation Area (Except Section 19)	10,064,681	231	745,532
1 ft. Section 19 Area	6,261,025	144	231,890
2 ft. Section 19 Area	TBD	TBD	TBD
TOTAL	56,563,531	1,299	2,467,712

FOR DISCUSSION PURPOSES ONLY

CENTRAL GSA SECTION 19 ACCESS ISSUES





MineShafts

Blocks

Lots

Section 19 RAML OWNED

REFERENCES:

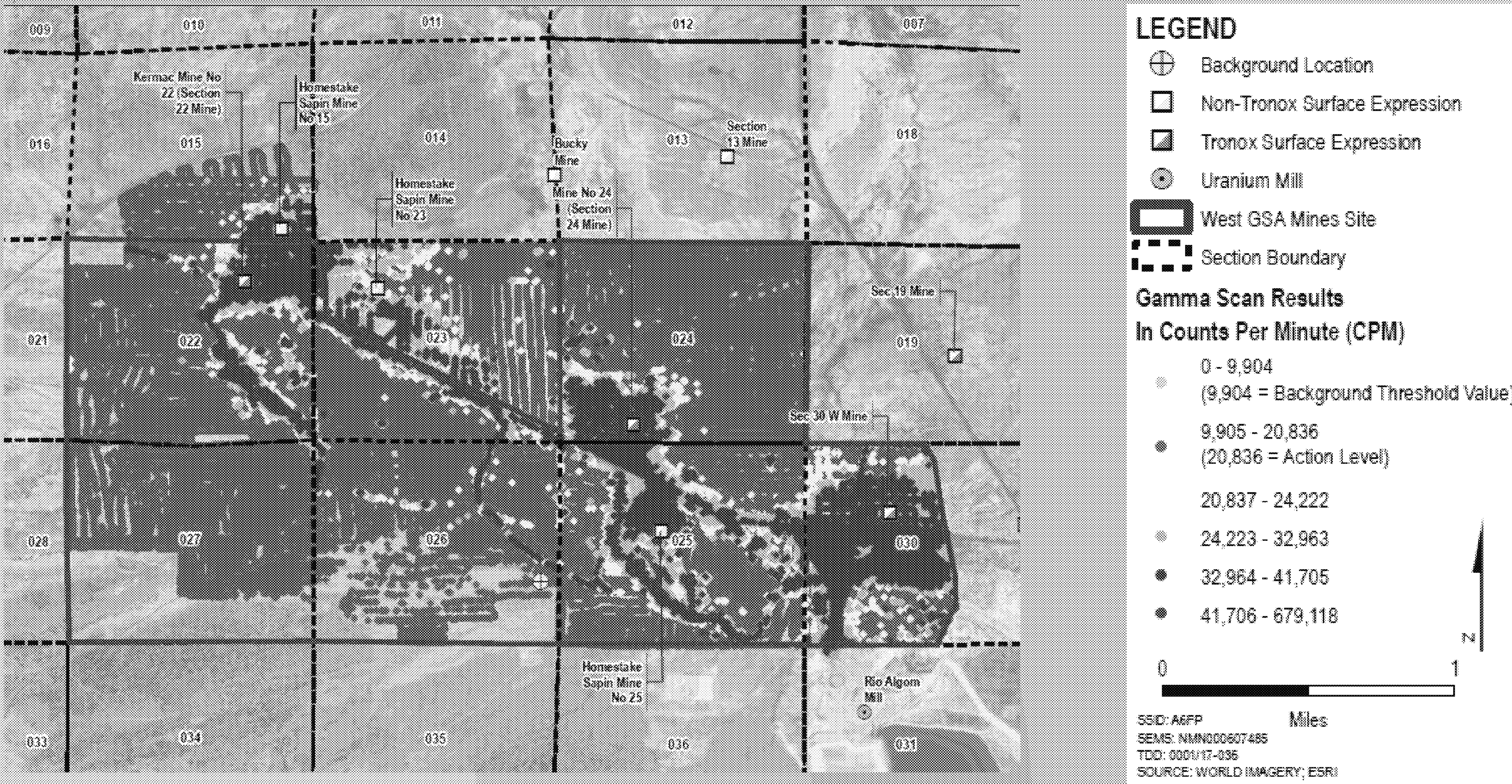
1) PROPERTY OWNERSHIP INFORMATION OBTAINED FROM QUIT CLAIM DEED RECORDS (McKINLEY COUNTY RECORDERS OFFICE)

2) TOTAL RAML OWNED LAND = 220.8 ACRES

FOR DISCUSSION PURPOSES ONLY

TRONOX NAUM WEST GEOGRAPHIC SUB-AREA

WEST GSA GAMMA SCAN

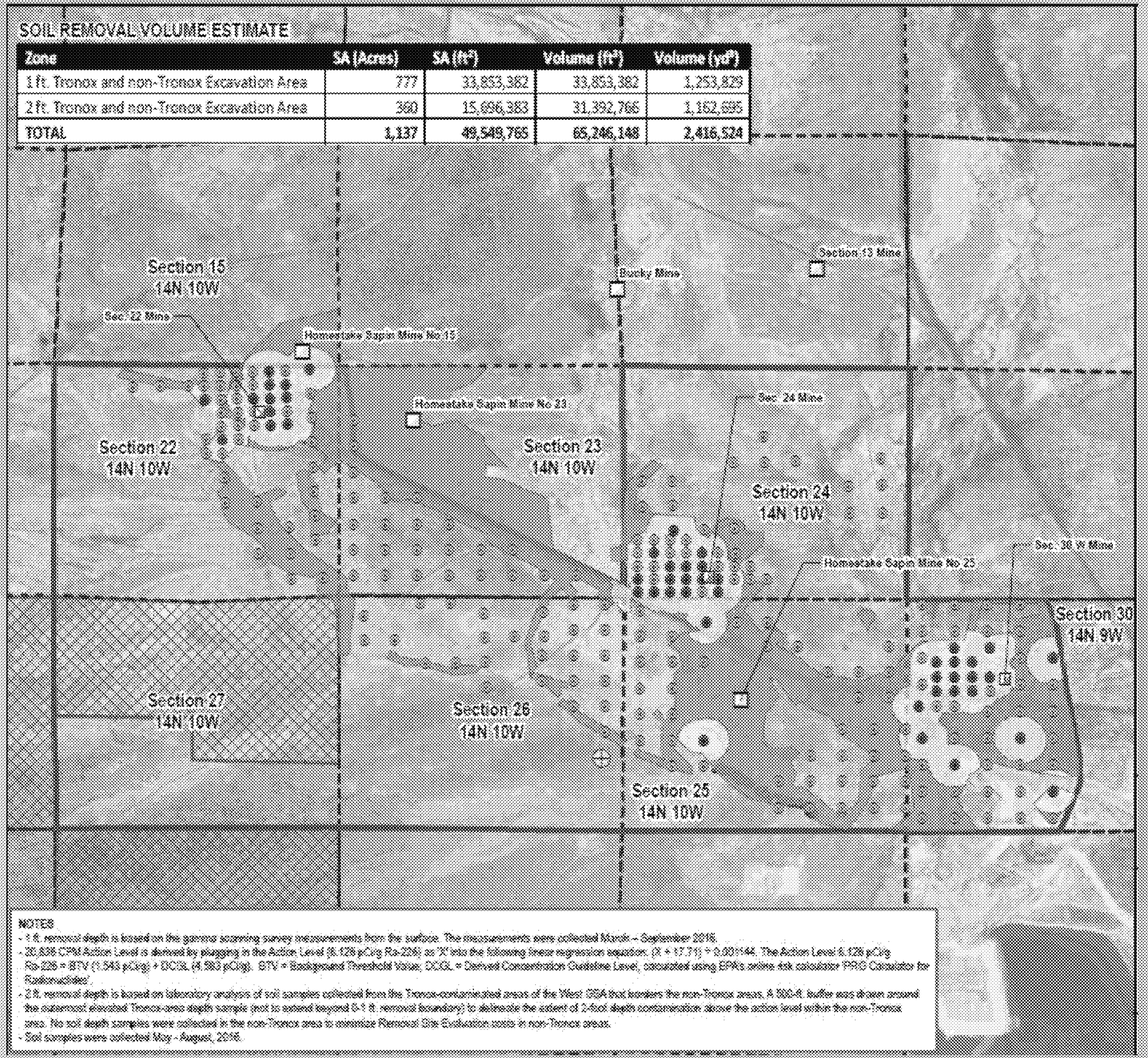


FOR DISCUSSION PURPOSES ONLY

WEST GSA REMOVAL FOOTPRINT

SOIL REMOVAL VOLUME ESTIMATE

Zone	SA (Acres)	SA (ft²)	Volume (ft³)	Volume (yd³)
1 ft. Tronox and non-Tronox Excavation Area	777	33,853,382	33,853,382	1,253,829
2 ft. Tronox and non-Tronox Excavation Area	360	15,696,383	31,392,766	1,162,695
TOTAL	1,137	49,549,765	65,246,148	2,416,524



NOTES
- 1 ft. removal depth is based on the gamma scanning survey measurements from the surface. The measurements were collected March – September 2016.
- 20,836 CPM Action Level is derived by plugging in the Action Level (6.126 pCi/g Ra-226) as "X" into the following linear regression equation: (X + 17.71) ÷ 0.001144. The Action Level 6.126 pCi/g Ra-226 = BTV (1.543 pCi/g) + DCGL (4.583 pCi/g). BTV = Background Threshold Value; DCGL = Derived Concentration Guideline Level, calculated using EPA's online risk calculator 'PRG Calculator for Radionuclides'.
- 2 ft. removal depth is based on laboratory analysis of soil samples collected from the Tronox-contaminated areas of the West GSA that borders the non-Tronox areas. A 500-ft. buffer was drawn around the outermost elevated Tronox-area depth sample (not to extend beyond 0-1 ft. removal boundary) to delineate the extent of 2-foot depth contamination above the action level within the non-Tronox area. No soil depth samples were collected in the non-Tronox area to minimize Removal Site Evaluation costs in non-Tronox areas.
- Soil samples were collected May - August, 2016.

Legend

- Background Location
- Non-Tronox Surface Expression
- Tronox Surface Expression
- West GSA Mines Site
- Navajo Allotment
- Section Boundary

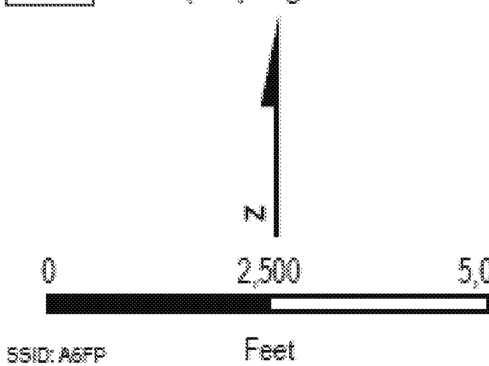
Soil Sample (2 ft. depth)

Concentration (pCi/g of Ra-226)

- ≤ 6.1
- > 6.1 (Action Level)

Depth of Excavation Area

- 0-1 ft. (20,836 CPM Action Level)
- 0-2 ft. (6.1 pCi/g of Ra-226 Action Level)

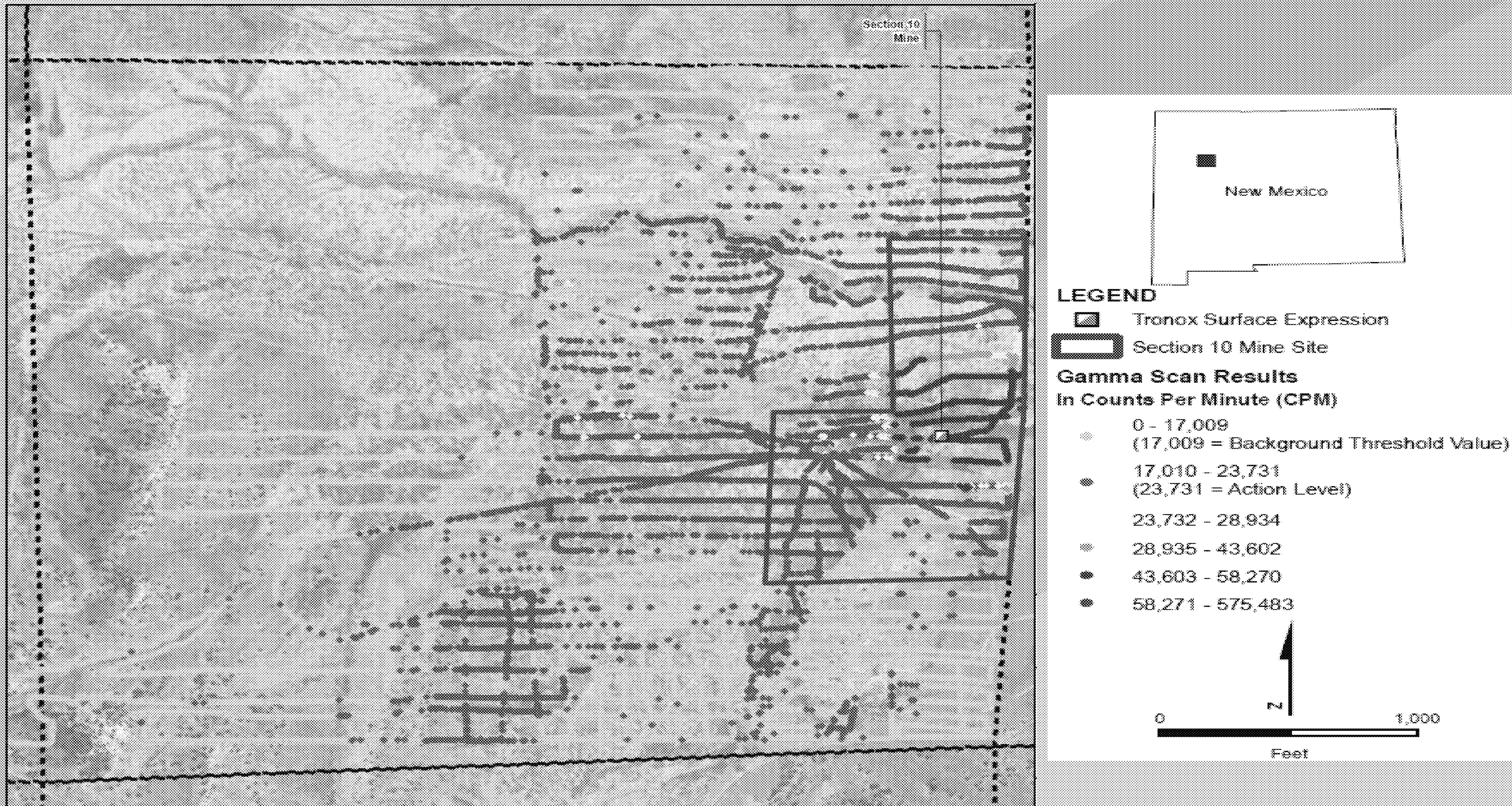


SSID: A6FP
SEMS: NMN000607485
TDD: 0001/17-036
SOURCE: WORLD IMAGERY; ESRI

FOR DISCUSSION PURPOSES ONLY

TRONOX NAUM SECTION 10 MINE

SECTION 10 GAMMA SCAN

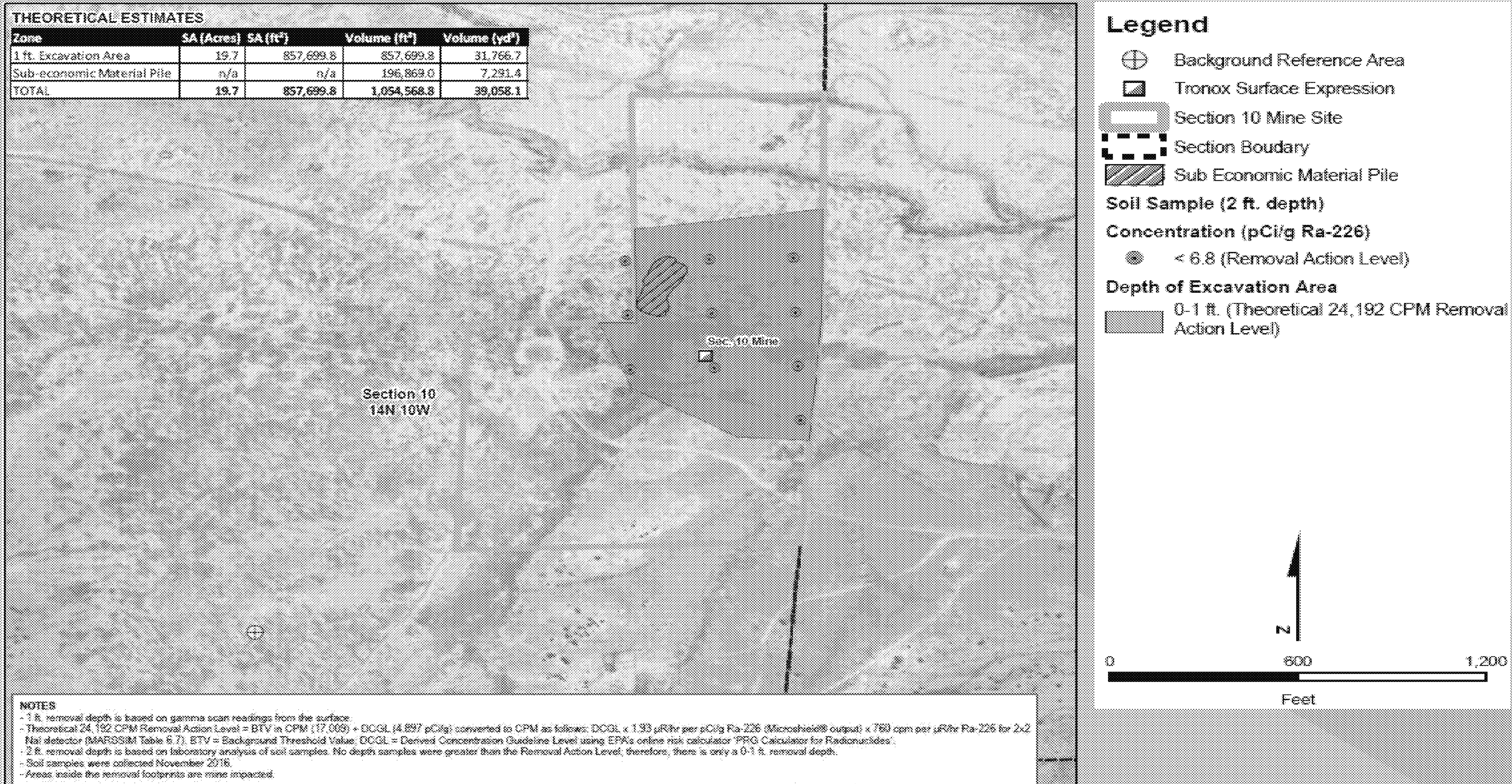


FOR DISCUSSION PURPOSES ONLY

SECTION 10 REMOVAL FOOTPRINT

THEORETICAL ESTIMATES

Zone	SA (Acres)	SA (ft²)	Volume (ft³)	Volume (yd³)
1 ft. Excavation Area	19.7	857,699.8	857,699.8	31,766.7
Sub-economic Material Pile	n/a	n/a	196,869.0	7,291.4
TOTAL	19.7	857,699.8	1,054,568.8	39,058.1



NOTES
- 1 ft. removal depth is based on gamma scan readings from the surface.
- Theoretical 24,192 CPM Removal Action Level = BTV in CPM (17,009) + DCGL (4.897 pCi/g) converted to CPM as follows: DCGL x 1.93 µR/hr per pCi/g Ra-226 (Microshield® output) x 760 cpm per µR/hr Ra-226 for 2x2 NaI detector (MARSSIM Table 6.7). BTV = Background Threshold Value; DCGL = Derived Concentration Guideline Level using EPA's online risk calculator 'PRG Calculator for Radionuclides'.
- 2 ft. removal depth is based on laboratory analysis of soil samples. No depth samples were greater than the Removal Action Level; therefore, there is only a 0-1 ft. removal depth.
- Soil samples were collected November 2016.
- Areas inside the removal footprints are mine impacted.

REMOVAL VOLUME ESTIMATES

Mine(s)	Surface Area		Volume
	Square Feet	Acres	Cubic Yards
East GSA	48,195,657	1,107	2,218,787
Central GSA*	56,563,531	1,299	2,467,712
West GSA	49,549,765	1,137	2,416,524
Section 10	857,700	20	39,058

* The estimate of the area exceeding the action level includes radiologically unsurveyed parcels in Section 19 because they are interspersed within surveyed areas that exceeded the action level, making it reasonably likely they also would exceed the action level.

QUESTIONS?

Message

From: Travis, Pamela [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=1FEBDA105B5A412DA2E53D0C44B60CE1-TRAVIS, PAMELA]
Sent: 8/31/2021 2:22:56 PM
To: sari.levin@sol.doi.gov
Subject: area-wide map
Attachments: SMCB_Basemap_2020_mod3.pdf

Here is a map that may help put the one I sent a few minutes ago into a broader geographic context. The Lower San Mateo Creek Study Area (a/k/a Central Study Area) is outlined in red.

Pam

Pamela J. Travis, Attorney
Office of Regional Counsel, Superfund Branch (6ORCDS)
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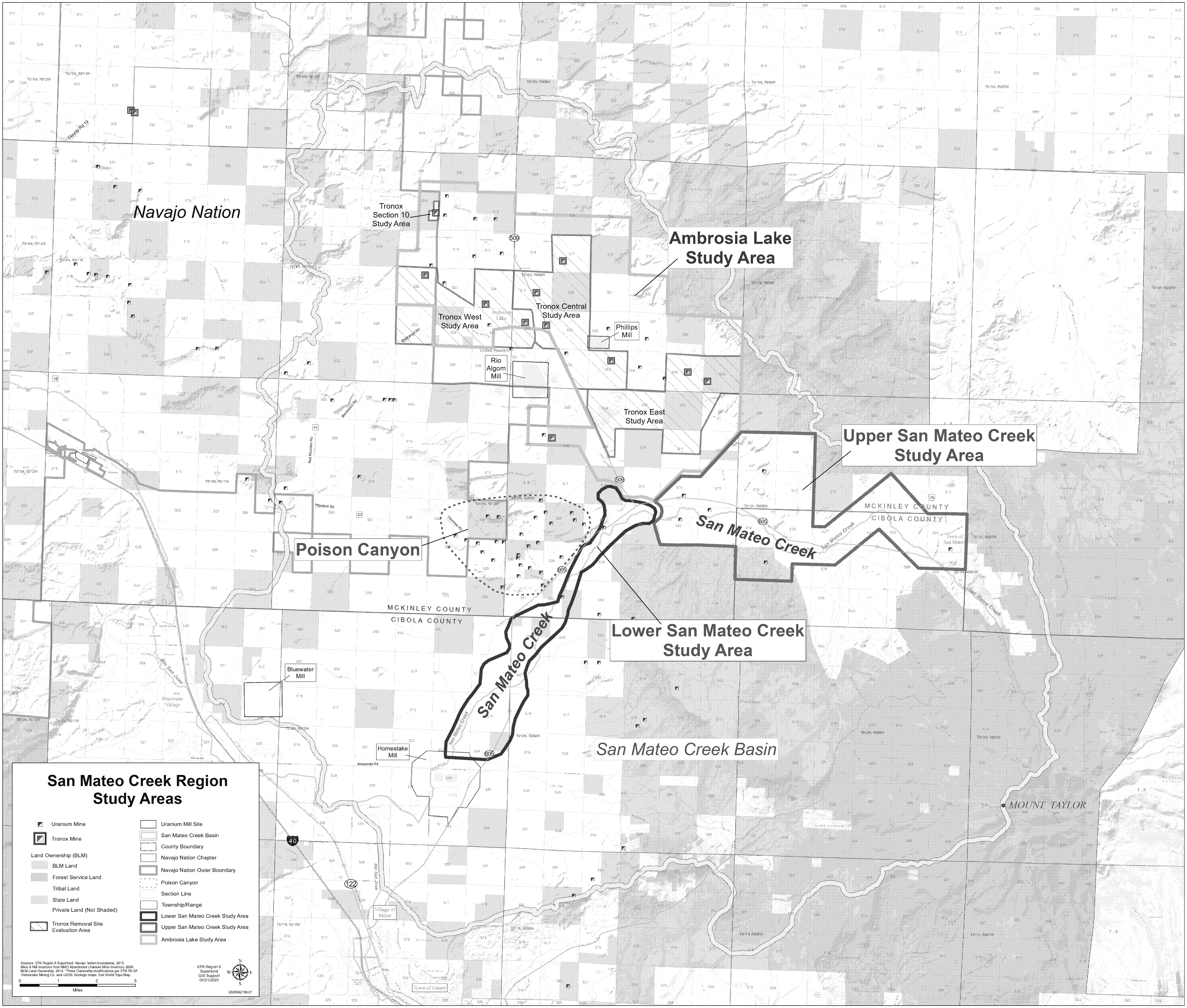

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